QC
770
U56
V5
No. 21

P.H. DILLARD
CHEMISTRY BUILDING
UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

UNITED STATES ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

Covering the Literature on Atomic Energy
in the Fields of

Biology Medicine Chemistry
Biophysics Physics Engineering
Metallurgy

Vol. 5 No. 21
Abstracts 6039-6553
Nov. 15, 1951

Technical Information Service, Oak Ridge, Tennessee

UNIVERSITY OF MICHIGAN LIBRARIES

Chemistry Library
QC
770
.U56
V.5
no.21

NUCLEAR SCIENCE ABSTRACTS

Vol. 5, No. 21, November 15, 1951

TABLE OF CONTENTS

Category	Abstract	Page
REPORTS REFERENCE LIST		iii
GENERAL	6039	917
Atomic Power	6039	
BIOLOGY AND MEDICINE	6042	917
Radiation Effects	6049	
Radiation Hazards and Protection	6080	
Radiation Sickness	6095	
Radiography	6096	
Radiotherapy	6098	
Toxicology Studies	6102	
Tracer Applications	6105	
CHEMISTRY	6111	925
Analytical Procedures	6121	
Crystallography and Crystal Structure	6136	
Deuterium and Deuterium Compounds	6139	
Fluorine and Fluorine Compounds	6141	
Graphite	6146	
Laboratories and Equipment	6148	
Radiation Chemistry	6150	
Radiation Effects	6156	
Rare Earths and Rare-earth Compounds	6157	
Separation Procedures	6164	
Sorption Phenomena	6172	
Syntheses	6174	
Tracer Applications	6181	
Transuranic Elements and Compounds	6184	
Uranium and Uranium Compounds	6185	
ENGINEERING	6187	934
Heat Transfer and Fluid Flow	6188	
Pumps	6195	
Radiography	6196	
MINERALOGY, METALLURGY, AND CERAMICS	6198	935
Ceramics and Refractories	6199	
Metals and Metallurgy	6202	
Minerals and Mineralogy	6235	
Tracer Applications	6240	
PHYSICS	6243	940
Astrophysics	6249	
Cosmic Radiation	6250	
Crystallography and Crystal Structure	6265	
Electrons	6266	
Gases	6271	

Category	Abstract	Page
PHYSICS		
Instruments	6273	
Isotopes	6289	
Mass Spectrography	6293	
Mathematics	6299	
Measuring Instruments and Techniques	6303	
Mesons	6351	
Molecular Properties	6374	
Neutrons	6378	
Nuclear Physics	6381	
Nuclear Properties	6396	
Nuclear Reactors	6426	
Nuclear Transformation	6431	
Particle Accelerators	6451	
Radiation Absorption and Scattering	6456	
Radiation Effects	6484	
Radioactivity	6486	
Spectroscopy	6535	
Theoretical Physics	6536	
AUTHOR INDEX		INDEX-1
NUMERICAL INDEX OF AEC REPORTS		INDEX-7
NNES ANNOUNCEMENT		A

REPORTS REFERENCE LIST

Vol. 5, No. 21

U. S. ATOMIC ENERGY COMMISSION DECLASSIFIED REPORTS

Report	Title, Author	Abstract
AECD-3243	Lattice Vibrations in Graphite. R. Gurney.	6146
AECD-3244	Some Problems in Eddy Diffusion. William Karush.	6189
AECD-3245	Effect of Imperfect Mixing in Streams. William Karush.	6188
AECD-3246	Proportional Fission Neutron Counters. R. C. Rohr, E. R. Rohrer, and R. L. Macklin.	6307
AECD-3247	The Use of Chelating Agents for Accelerating Excretion of Radioelements. Harry Foreman and Joseph G. Hamilton.	6043
AECD-3248	A Hydrogen Liquefier Using Neon as an Intermediate. Charles B. Hood and E. R. Grilly.	6281

U. S. ATOMIC ENERGY COMMISSION UNCLASSIFIED REPORTS

AECU-1560	Research in Nuclear Physics; Progress Report No. I.	6382
AECU-1611	On the Roles of Purines and Purine Precursors in the Formation of the Nucleic Acids. Aaron Bendich.	6105
AECU-1612	Some Applications of Radioactive Tracers to Physical Chemical Problems. John E. Willard.	6181
AECU-1613	Studies on the Structure of Nucleic Acids V; On the Mechanism of Metal and Enzyme Interactions. Liebe F. Cavalieri.	6122
AECU-1614	Total Cross Sections of Heavy Nuclei for Fast Neutrons. D. W. Miller, R. E. Fields, and C. K. Bockelman.	6399
AECU-1615	Threshold Values of Internal Conversion Coefficients for the K-Shell. B. I. Spinrad and L. B. Keller.	6487
AECU-1616	Skin Changes Produced by Low Voltage Roentgen Ray Irradiation; Final Report. Marion B. Sulzberger, Rudolf L. Baer, and Alexander Borota.	6049
AECU-1617	Metabolism of Soybean Leaves V; Translocation from Soybean Leaves. Leo P. Vernon and S. Aronoff.	6042
AECU-1618	Classification of Levels in Al^{28}. L. J. Koester.	6398
AECU-1619	Basic Radiation Damage Studies with Charged Particles; Final Technical Report; July 1, 1950-June 30, 1951.	6484
AECU-1620	Lung Carcinoma in an Industrial Population at an Atomic Pile Site. Robert A. Love.	6051
AECU-1621	Neutron Flux Scanner. W. Bernstein, E. H. Foster, and J. J. Floyd.	6276
AECU-1622	Total Cross Sections of Carbon and Hydrogen for 14-Mev Neutrons. H. L. Poss, E. O. Salant, and L. C. L. Yuan.	6396
AECU-1623	The Decay of Rh^{106}. (abstract) David E. Alburger.	6486
AECU-1624	The Mass Synchrometer. (abstract) Lincoln G. Smith.	6293

Report	Title, Author	Abstract
AECU-1625	Isomerism of Sr^{85}. A. W. Sunyar, J. W. Mihelich, G. Scharff-Goldhaber, M. Deutsch, and M. Goldhaber.	6488
AECU-1626	Angular Correlation of Rh^{106}. (abstract) J. J. Kraushaar.	6490
AECU-1627	Fredholm Structures in Positron Theory. Maurice Neuman.	6536
AECU-1628	The Action of X-rays on Fibrinogen Solutions. H. A. Scheraga and L. F. Nims.	6050
AECU-1629	A Simple Ion-Gauge Regulator. Paul I. Richards and W. Ansel Tuthill.	6277
AECU-1630	A-C Operation of Ionization Chambers. R. M. Kiehn.	6308
AECU-1631	Nuclear Fuel for Power Production. John F. Flagg and M. J. Gross.	6039
AECU-1632	A New Type Automatic Radioassayer. Saul J. Harris and Anthony Del Duca.	6279
AECU-1633	A Reproducible Method for Sampling and Counting Cells in the Adenohypophysis. G. M. Mateyko.	6045
AECU-1634	A Phenomenological Treatment of Photomeson Production from Deuterons. C. F. Chew and H. W. Lewis.	6352
AECU-1635	Neutron Refraction in O_2, N_2, He, A Gases. A. W. McReynolds.	6397
AECU-1636	Experiments on Compound Formation in Solutions at Low Temperatures; Iodine and Olefins. Simon Freed and Kenneth M. Sancier.	6116
AECU-1637	Mass Measurements with a Magnetic Time-of-Flight Mass Spectrometer. E. E. Hays, P. I. Richards, and S. A. Goudsmit.	6294
AECU-1638	Energy Response of NaI (Tl) Crystals to Alpha Particles of Less Than 10 Mev. Ralph H. Lovberg.	6310
AECU-1639	Thermal Ratcheting. J. E. Burke and Anna M. Turkalo.	6212
AECU-1640	The Vapor Pressure of Liquid Mercury from the Triple Point to the Critical Point. Leo F. Epstein and Marion D. Powers.	6117
ANL-4666	Radium Toxicity Program; A Progress Report of Clinical Studies on Twenty-four Patients. William B. Looney.	6046
BNL-117	Quarterly Progress Report; April 1-June 30, 1951.	6243
BNL-117(p.1-16, 69-81)	Physics, p.1-16, 69-81 of Quarterly Progress Report; April 1-June 30, 1951.	6244
BNL-117(p.17-25, 61-2)	Instrumentation and Health Physics, p.17-25, 61-2 of Quarterly Progress Report; April 1-June 30, 1951.	6304
BNL-117(p.26-30)	Accelerator, p.26-30 of Quarterly Progress Report; April 1-June 30, 1951.	6451
BNL-117(p.31-43, 49-61, 63-8)	Chemistry, p.31-43, 49-61, 63-8 of Quarterly Progress Report; April 1-June 30, 1951.	6113
BNL-117(p.44-9, 94-121)	Biology and Medicine, p.44-9, 94-121 of Quarterly Progress Report; April 1-June 30, 1951.	6044
BNL-117(p.82-93)	Reactor Science and Engineering, p.82-93 of Quarterly Progress Report; April 1-June 30, 1951.	6426
CH-3907	The Acute Lethal Action of Single Doses of X-rays on Guinea Pigs. C. W. Hagen, Jr. and G. A. Sacher.	6052
COO-32	Phase Diagrams of Zirconium-base Binary Alloys; Report No. 4; July 1-September 1, 1951.	6211
HW-20999	The Second Annual Report of the Botany Field Station. J. F. Cline and J. W. Porter.	6082
ISC-140	Development of a Process for the Production of a High Hafnium Concentrate. A. Jacobs, R. D. Masteller, and G. H. Beyer.	6165
ISC-172	Measurement of the D. C. Resistance of Selenium and Copper Oxide Rectifiers below Room Temperature. D. M. Grimes and Sam Legvold.	6280
ISC-173	On the Theoretical Calculation of Transition Probabilities. Harrison Shull and Frank O. Ellison.	6374
LA-1287	Criteria of Stability for the Numerical Solution of Partial Differential Equations. Herbert A. Forrester.	6299

Report	Title, Author	Abstract
NAA-SR-144	Theoretical Estimate of the Effect of Interstitial Atoms and Vacancies on the Elastic Coefficients of Simple Metals. G. J. Dienes.	6210
NAA-SR-145	Economic Factors in the Selection of Steam Temperatures in Nuclear Power Plant. R. Elliott.	6040
NYO-579	Solid Solutions and Grain Boundaries; Technical Progress Report No. 7, Scope II. B. L. Averbach, M. Cohen, P. Flinn, L. Seigle, and E. E. Underwood.	6209
NYO-826	Electrochemical Studies of Non-aqueous Melts; Quarterly Progress Report; Period Ending June 1, 1951. Robert F. Mehl and Gerhard Derge.	6205
NYO-1627	The Effect of Ionizing Radiation on the Desoxyribonucleic Acid Content of Rat Thymus Nuclei. Helen Harrington and Paul S. Lavik.	6053
ORNL-1009	Heat Reactivation of Ultraviolet-inactivated Bacteria. Edward H. Anderson.	6047
ORNL-1068	The Total Neutron Cross Section of Holmium as a Function of Energy. T. E. Stephenson.	6400
ORNL-1069	Physical Behavior of the H_2-O_2-H_2O System Under Pressure. J. M. Smith and D. L. Katz.	6114
ORNL-1084	The Nomenclature of Organic Compounds Containing Isotopic Carbon. Clair J. Collins, Charles E. Crompton, Anthony R. Ronzio, and Bert M. Tolbert.	6115
ORNL-1087	Heat Capacity of Molybdenum. T. A. Redfield and J. H. Hill.	6208
ORNL-1102	On the Theory of the Inner Bremsstrahlung in β-Processes. J. M. Jauch.	6381
ORO-47	Enamels for Metals. J. H. Handwerk and T. N. McVay.	6198
SEP-58(X)(rev.)	The Hot-wire Process for Zirconium. Robert B. Holden and Bernard Kopelman.	6207
SO-1005	Jet Impactors for Determining the Particle Size Distribution of Aerosols (Technical Report No. 4). W. E. Ranz and J. B. Wong	6081
UCRL-1224	New Isotopes of Berkelium and Californium. E. K. Hulet, S. G. Thompson, A. Ghiorso, and K. Street, Jr.	6489
UCRL-1246	Summary of the Research Progress Meeting of April 12, 1951. Bonnie E. Cushman.	6383
UCRL-1407	Complex Ions of Lanthanum in Aqueous Solutions (dissertation). Kenneth Lawrence Mattern.	6157
UCRL-1414	Distribution of a Finite Particle Beam After Being Multiply Scattered by a Thin Foil. Val J. Ashby.	6456
UCRL-1432	Pulse Height Distribution Analyzer II. William E. Glenn.	6278
UCRL-1433	π^+-Meson Production Cross-section as a Function of Atomic Number. D. Hamlin, M. Jakobson, J. Merritt, and A. Schulz.	6353
UCRL-1447	The Differential Cross Section for the Scattering of 9.5-Mev Protons from Helium (thesis). Thomas Milton Putnam, Jr.	6457
UCRL-1451	Orbits in a Proposed Spherical Electrostatic Spectrometer. A. A. Garren.	6275
UCRL-1463	Centrifugal Sodium Pump for the Purification of Inert Atmospheres. LeRoy A. Bromley, Russell K. Edwards, and Raleigh L. McKisson.	6195
UCRL-1467	π-Meson Production by Protons on Nuclei. Ernest M. Henley.	6351
UR-167	A Chemical Dosimeter for Ionizing Radiations. John W. Kanwisher.	6309
Y-811	Alkali Metals Area Safety Guide. Preston L. Hill.	6206

OTHER UNCLASSIFIED REPORTS OF SPECIAL INTEREST TO AEC LABORATORIES

CRC-451	Memorandum on the Use of Dry Boxes for Handling Active Material (CI-178 Revised, July 1950). P. B. Aiten.	6080
IM-5	A.E.P. 908 Scaler; Provisional Installation and Operating Instructions. W. D. Howell.	6273
LP-27	Detection of Slow Neutrons. B. W. Sargent.	6379
MX-228	The Determination of Microgram Amounts of Boron in Calcium and Magnesium Metals. H. A. Bewick, F. E. Beamish, and J. C. Bartlet.	6121

Report	Title, Author	Abstract
NAA-AL-699	The Analysis and Design of Hydrodynamic Gas Bearings. R. R. Weber.	6187
NP-2385	On the Motion of Neutrons in Hydrogenous Substances; trans from Ricerca Scientifica VII, 2, 13 (1936). Enrico Fermi; tr. G. M. Temmer.	6378
NP-3332	Your Guide to Radiological Safety. Paul C. Thompkins, Director.	6083
NP-3333	Three Keys to Radiological Safety. Paul C. Thompkins, Director.	6084
NP-3339	Physical Chemistry of Gallium-Indium Alloys; Status Report July 1-September 30, 1948.	6204
NP-3340	Physical Chemistry of Gallium-Indium Alloys; Status Report April 1, 1948-June 30, 1948. J. Hugh Hamilton, John R. Lewis, and J. P. Denny.	6202
NP-3341	Studies on Aminoboron Compounds; Second Annual Summary Technical Report of Investigations on Water-reactive Chemical Compounds. Anton B. Burg, C. Lowell Randolph, Jr., George W. Campbell, Jr., Ernest S. Kuljian, and Arthur J. Stosick.	6112
NP-3342	Studies on Aminoboron Compounds; First Annual Summary Report of Investigations on Water-reactive Chemical Compounds. Anton B. Burg, C. Lowell Randolph, Jr., Theodore E. Steinberg, George W. Campbell, Jr., and Arthur J. Stosick.	6111
NP-3343	Physical Chemistry of Gallium-Indium Alloys; Status Report October 1-December 31, 1948. J. Hugh Hamilton, John R. Lewis, and J. P. Denny.	6203
NP-3348	The Effect of Ultrasonic Radiation on the Electrolytic Separation of Deuterium. Donald F. Mason, Royce E. Biddick, and Charles A. Boyd.	6164
NP-3359	On Processing Nuclear Emulsions; Part II After Development Techniques. A. Bonetti, C. C. Dilworth, and G. P. S. Occhialini.	6306
NP-3362	Data for Assay of Radioactive Materials with Geiger Counter Equipment; Technical Communication No. 33. T. H. Oddie and S. A. Mibus.	6303
NP-3368	Proceedings of Conference on Applications of Isotopes in Scientific Research; August 1950.	6289
NP-3369	Magnetic Analysis of the Charged Particle Groups Produced by the Bombardment of Carbon, Beryllium, and Oxygen with Deuterons (thesis). Ernest D. Klema.	6431
PA-14	The Design of a Precision Double Monochromator. W. H. Steel.	6274
PR-P-11-E	Progress Report May 16-August 15, 1951; Electronics Branch. J. Hardwick.	6305

GENERAL

ATOMIC POWER

6039

Knolls Atomic Power Lab.

NUCLEAR FUEL FOR POWER PRODUCTION; by John F. Flagg and M. J. Gross. June 26, 1951. 13p. (AECU-1631)

The basic concepts involved in the use of nuclear fuel for power production are discussed in a general nontechnical way. No specific data are given. The paper is not intended for scientists in the field but provides a good background for the lay reader.

6040

North American Aviation, Inc.

ECONOMIC FACTORS IN THE SELECTION OF STEAM TEMPERATURES IN NUCLEAR POWER PLANTS; by R. Elliott. Aug. 20, 1951. 24p. (NAA-SR-145)

An analysis is made of optimum steam temperatures for use in electric power stations. Results are given in terms of the cost per unit of electric power delivered at the station as a function of fuel cost per unit of heating value and of steam temperature. It is shown that the most economical steam temperature is in the range 600 to 800°F in situations where heat is supplied at no expense to the power plant. This would be the case where the cost of a nuclear reactor supplying the heat is subsidized by the value of the fissionable products formed. Enough information is given so that the results may be extended to the cases where part or all of the cost of the nuclear fuel is chargeable to the account of the electric generating plant. This analysis may be applied wherever heat is available without fuel cost, such as in certain chemical processes and in schemes for using solar or subterranean heat. (auth)

6041

OPPORTUNITIES IN ATOMIC ENERGY. Karl D. Hartzell. New York, Vocational Guidance Manuals, Grosset and Dunlap, 1951. 144p.

The American program for development of atomic energy is reviewed. The organization and functions of the AEC and its contractors are outlined. Personnel requirements, opportunities, and average salaries are listed.

BIOLOGY AND MEDICINE

6042

Iowa State Coll.

METABOLISM OF SOYBEAN LEAVES V; TRANSLOCATION FROM SOYBEAN LEAVES; by Leo P. Vernon and S. Aronoff. [nd] 24p. (AECU-1617)

The process of translocation in the soybean plant has been studied by means of $C^{14}O_2$ photosynthesis by the first trifoliate leaf only, followed by qualitative and quantitative analysis of the plant for radioactive material. Within 20 min the following radioactive compounds, in the order of decreasing radioactivity, were found in the leaf extract: sucrose, alanine, glutamic acid, glyceric acid, glucose, raffinose, fructose, malic acid, triose, isocitric acid, succinic acid, aspartic acid, and citric acid. Analysis of tip and stem sections revealed activity only in sucrose, glucose, and fructose. In all cases sucrose was the main compound. Starch was the main radioactive compound found in the insoluble fraction. From activity curves for a 5- and a 20-min translocation, a rate of translocation of sucrose of 1.4 cm/min was obtained. Sucrose has the highest rate of translocation followed by glucose and fructose, respectively.

6043

Radiation Lab., Univ. of Calif.

THE USE OF CHELATING AGENTS FOR ACCELERATING EXCRETION OF RADIOELEMENTS; by Harry Foreman and Joseph G. Hamilton. June 14, 1951. Decl. Sept. 21, 1951. 18p. (AECD-3247)

The chelating action of (ethylenediamine)tetraacetic acid (EDTA) was investigated as a means of accelerating the excretion of radioelements which have become fixed in the animal skeleton. Rats injected with Y^{91} followed by the administration of Ca EDTA showed excretion of Y^{91} greatly increased when compared with controls which received Y^{91} alone. Rats receiving both Ce^{144} and Pu^{239}, followed by Ca EDTA showed an increase in urinary excretion of Ce when given during the first 24 hr following injection of the isotope. Ca EDTA enhanced urinary excretion of Pu to levels which were approximately 10 times greater than that of control animals. The effect lasted for several days after the cessation of treatment. Fecal excretion of Pu was not affected by the chelating agent except when Ca EDTA was administered during the first 24 hr, at which time there was a marked rise in Pu excretion.

6044

Brookhaven National Lab.

BIOLOGY AND MEDICINE, p.44-9, 94-121 of QUARTERLY PROGRESS REPORT; APRIL 1–JUNE 30, 1951. Issued Aug. 1951. 34p. (BNL-117(p.44-9, 94-121))

A report on the distribution of C^{14}-labeled methyl and n-butyl alcohol between human erythrocytes and external saline solution is presented. Studies on the cytochemical effects of x rays on Trillium pollen mother cells and rat organs; effect of continuous γ radiation on starch formation in Zea mays pollen; effects of radiation on weight of rats, on survival of hypophysectomized rats, and on red-cell metabolism; phosphorylation mechanisms in carbohydrate metabolism; relation of nucleic acid metabolism to the genetic effect of radiation in bacteria; mold and bacteria metabolism; equations for retention by a mouse of C^{14} from ingested C^{14}-sucrose; and the fate of C^{14}-Periston are summarized. Medical studies on radiation effects, viability of intraocular tissue transplants, effect of spleen

and lymph node transplants on survival of Co^{60}-γ-irradiated mice, absence of mouse species antigen in mouse carcinoma propagated on chick embryos, and other biochemical and tracer experiments also are summarized.

6045

Brookhaven National Lab.

A REPRODUCIBLE METHOD FOR SAMPLING AND COUNTING CELLS IN THE ADENOHYPOPHYSIS; by G. M. Mateyko. [nd] 9p. (AECU-1633)

Sampling and counting of hypophyseal cells across the entire horizontal and vertical axes of selected sections of the pars anterior gives reliable data on both the absolute and relative cellular proportions in the adenohypophysis of the rat. Critical evaluation reveals that this method is reproducible, appropriately precise, and expedient.

6046

Argonne National Lab.

RADIUM TOXICITY PROGRAM; A PROGRESS REPORT OF CLINICAL STUDIES ON TWENTY-FOUR PATIENTS; by William B. Looney. July 1951. 48p. (ANL-4666)

Clinical studies were made of a group of 24 patients who received radium chloride 20 yr previously. Clinical data presented include estimation of total-body radium by radon breath and γ-ray body measurements; clinical history; physical examination; hematological studies; serum calcium, phosphorus, and alkaline phosphatase determinations; Kahn test; dental examination, including dental x rays; and roentgenographic examination of the skeleton. The amount of radium present in the body was determined as the sum of the emanating and nonemanating fractions obtained by analysis of the radon content of the expired air and by measurement of γ-ray activity from the patients' bodies. Results of complete roentgenographic examination of the skeleton of 19 of the 24 patients is given. Seventeen of the 19 patients had changes in bone density, and, in 8 of the 19, changes in normal configuration of bone were present. No direct relationship was observed between the roentenographic changes or symptomatology and the amount of radium remaining in the body. It was concluded that radium plus an unknown factor or factors combine to produce bone degeneration.

6047

Oak Ridge National Lab.

HEAT REACTIVATION OF ULTRAVIOLET-INACTIVATED BACTERIA; by Edward H. Anderson. Issued Oct. 3, 1951. 15p. (ORNL-1009)

Ultraviolet-inactivated cells of several strains of Escherichia coli and Saccharomyces cerevisiae have been tested for their ability to be reactivated as a result of heat treatment after irradiation. The magnitude of reactivation obtained, with a 10° difference in incubation temperature, for two strains of E. coli approximates that obtained by photoreactivation. The heat-reactivation phenomenon does not occur to any appreciable extent in x-ray-inactivated B/r cells and only slightly in B cells. Heat reactivation may not be as general a phenomenon as photoreactivation. (auth)

6048

THE INCORPORATION OF α-C^{14}-ACETATE INTO THE STROMA OF THE ERYTHROCYTE. Kurt I. Altman, Robert N. Watman, and Kurt Salmon. Arch. Biochem. Biophys. 33, 168-9(1951) Aug. (Letter to the editor)

The metabolism of erythrocyte stroma has been investigated concerning the formation and behavior of the red cell under various physiological and pathological conditions using α-C^{14}-acetate as stroma precursor. Acetate was rapidly incorporated into the stroma of the erythrocyte and there was a rapid turnover of the C^{14}-labeled constituents of the stroma. This is interpreted to mean that, unlike the circulating red cell hemoglobin, the labeled stroma components are metabolically active and perhaps exchange with chemically identical plasma constituents. The highest isotope concentrations in stroma were observed in the splenectomized rabbit, suggesting that in the absence of spleen the catabolic phase of stroma metabolism is altered. In an animal rendered anemic, stroma C^{14} activities also exceeded those of the control animals. However, in contrast to the splenectomized animal, the rise in stroma activity was paralleled by a simultaneous, significant increase above control levels in isotope incorporation into hemoglobin. This suggests that the mechanism underlying the increased C^{14} incorporation into the stroma of the anemic rabbit is different from that causing the increased isotope concentration in the stroma of the splenectomized rabbit.

RADIATION EFFECTS

6049

New York Univ. Hospital

SKIN CHANGES PRODUCED BY LOW VOLTAGE ROENTGEN RAY IRRADIATION; FINAL REPORT; by Marion B. Sulzberger, Rudolf L. Baer, and Alexander Borota. [nd] 25p. (AECU-1616)

A study was made of the skin of individuals who 5 to 25 years previously had received superficial low-voltage roentgen-ray treatments for nonmalignant, benign skin conditions. Conclusions, based upon the findings on reexamination of 1439 irradiated patients and 1386 nonirradiated control cases, were that superficial roentgen-ray treatments as given by dermatologists in the United States, in the doses necessary for the cure of cancers and other malignancies of the skin, produce mild roentgen sequelae in about 28% of cases, and that superficial roentgen-ray treatments in the fractional doses and in the qualities generally employed by dermatologists in the United States for the treatment of benign dermatoses, such as acne vulgaris, "eczema," "neurodermatitis," psoriasis, etc., do not produce any sequelae in total doses up to 1000 r. When total doses of more than 1000 r are given, it may be expected that about 1.2% of patients will develop roentgen sequelae which are relatively mild and of only cosmetic importance.

6050

Brookhaven National Lab.

THE ACTION OF X-RAYS ON FIBRINOGEN SOLUTIONS; by H. A. Scheraga and L. F. Nims. [nd] 21p. (AECU-1628)

Irradiation of fibrinogen solutions leads to fragmentation as well as polymerization of the original fibrinogen molecule. Irradiated solutions exhibit increased viscosity and, at doses greater than 300 kr, gel spontaneously. The magnitude of the changes can be decreased by the addition of protecting agents. The kinetics of the irradiation reactions are in accord with the hypothesis that the action of the x rays involves free radicals resulting from the ionization of water molecules. Despite the marked changes in the structure of fibrinogen produced by x rays, all of the material is recoverable as fibrin upon addition of thrombin even when only 10% of the native fibrinogen is left. It seems evident, therefore, that the split fragments resulting from the x irradiation contain the groups necessary for the clotting reaction and that these are not those easily oxidized by OH radicals. (auth)

6051

Brookhaven National Lab.

LUNG CARCINOMA IN AN INDUSTRIAL POPULATION AT AN ATOMIC PILE SITE; by Robert A. Love. [nd] 3p. (AECU-1620)

Incidence of primary lung carcinoma was found to be much higher than expected in the industrial population at

Brookhaven National Laboratory during a 1-yr period. Radiation exposure was shown to be in no way responsible for this high incidence.

6052
Metallurgical Lab., Univ. of Chicago
THE ACUTE LETHAL ACTION OF SINGLE DOSES OF X-RAYS ON GUINEA PIGS; by C. W. Hagen, Jr. and G. A. Sacher. Aug. 1951. 12p. (CH-3907)

Groups of guinea pigs were exposed to x-ray doses ranging from 0 to 800 r and their survival followed for 90 days thereafter. The guinea pig dosage survival curve is very broad, almost exponential in form. The LD_{50} is about 200 r. The relation of mean survival time to dose was determined and it was found that the mean survival times of guinea pigs exposed to lethal doses are quantitatively similar to those of the other experimental animals.

6053
Western Reserve Univ. School of Medicine
THE EFFECT OF IONIZING RADIATION ON THE DESOXYRIBONUCLEIC ACID CONTENT OF RAT THYMUS NUCLEI; by Helen Harrington and Paul S. Lavik. Issued Sept. 27, 1951. 16p. (NYO-1627)

The DNA phosphorus content per nucleus has been determined in thymus cells of normal and irradiated rats, and it has been found that irradiation causes no significant change in this value. Since there is a decrease in the DNA phosphorus concentration of thymus tissue following irradiation, several mechanisms of radiation action which could cause a decrease in DNA phosphorus concentration while allowing the DNA phosphorus per nucleus to remain unchanged are discussed. It has been suggested that an inhibition of DNA synthesis, resulting in a decreased new cell production, followed by the elimination of old lymphocytes from the thymus could account for both experimental findings. (auth)

6054
EFFECT OF WHOLE BODY X-IRRADIATION ON THE STORAGE OF IRON IN LIVER, SPLEEN, AND KIDNEY OF RATS. Stephan Ludewig and Alfred Chanutin. Am. J. Physiol. 166, 384-6(1951) Aug. 1.

The iron contents of the liver, spleen, and kidneys of rats were determined at varying intervals after whole body exposure to x-ray doses of 500 r. The values for the liver and spleen increased steadily during the first two weeks and decreased during the third week following irradiation. Small increases were noted in the kidneys during the second post-radiation week. Unusually high iron values were observed in the liver and spleen of anemic irradiated rats. A derangement in iron metabolism follows x-irradiation and is manifested by the storage of excess iron in tissues. (auth)

6055
EFFECT OF WHOLE BODY X-IRRADIATION ON SERUM IRON CONCENTRATION OF RATS. Alfred Chanutin and Stephan Ludewig. Am. J. Physiol. 166, 380-3(1951) Aug. 1.

Serum iron concentrations were determined in male and female rats exposed to total body irradiation with x-rays in doses varying from 10 to 1500 r. The average values are significantly increased in both groups during the first day following irradiation with doses of 100 r or greater. Subsequently, the serum iron concentrations remained elevated for about a week in the 500- and 600-r groups. Male animals appeared to be more sensitive to irradiation as judged by the increased values for serum iron. (auth)

6056
HEMATOLOGY OF THE DOG FOLLOWING INTRAVENOUS ADMINISTRATION OF RADIOACTIVE COLLOIDAL GOLD. Brownell Wheeler, Marvin A. Jackson, and Paul F. Hahn. Am. J. Physiol. 166, 323-7(1951) Aug. 1.

Fourteen dogs were injected with 1 mc/kg of Au^{198} by vein. All the dogs showed a definite decrease in white count, but only one was thrown into a marked leukopenia. In 12 out of 14 dogs sedimentation rate increased following radiation, although this response was not as clear cut as the decrease in white count. Hemoglobin and hematocrit decreased in a slow and progressive manner over a period of several weeks. Liver function tests failed to reveal any marked degree of hepatic impairment, but a few dogs showed changes indicative of mild liver damage. Some of the possible mechanisms for these changes are discussed briefly. The results show that intravenous administration of radioactive colloidal gold at dosage levels similar to those employed therapeutically in the treatment of leukemia and cancer is relatively well tolerated by normal dogs. It seems probable, therefore, that, insofar as hematological changes and liver functions are concerned, these dosage levels present little immediate danger to patients who receive them. (auth)

6057
ON THE POSSIBILITY OF DEMONSTRATING X-RAY AND Ra DAMAGE IN PERSONNEL BY OBSERVATION OF THE PROTHROMBIN LEVEL IN THE BLOOD. F. K. Beller, Jr. Fortschr. Gebiete Roentgenstrahlen 75, 95-8(1951) July. (In German)

Through observations on the personnel of a radiological institute, it is established that slight radiation injuries cannot be demonstrated by the decrease of the prothrombin level. It appears that, in a general way, x rays do not affect the clotting potential of the blood. This conclusion is confirmed by the fact that various authors give discordant information on changes produced by radiations in the differential blood picture and in the coagulation time. (auth)

6058
STUDIES ON THE EFFECT OF X-IRRADIATION UPON PELOMYXA CAROLINENSIS WITH SPECIAL REFERENCE TO NUCLEAR DIVISION AND PLASMOTOMY. E. W. Daniels. J. Expt. Zool. 117, 189-209(1951) June.

The effect of x irradiation upon reproduction of Pelomyxa carolinensis (an amoebad Protozoa) was studied. The median lethal dose was determined to be 96,000 r, and the shape of the survival curve to be sigmoid. With dosages between 15,000 and 140,000 r, a pronounced delay was shown in the first plasmotomy (division) following x irradiation during interphase. Greater delay was produced as the dosage was increased. X irradiation did not change the frequency of simple plasmotomies. Plasmogamy (fusion) of x-irradiated halves to their nonirradiated sisters tended to prevent the delay otherwise observed between exposure and the first mitosis. In cellular systems containing both x-irradiated and nonirradiated nuclei (and cytoplasm), the nuclei still, as in a normal individual, were observed to undergo mitosis at precisely the same time.

6059
EXPERIMENTAL RADIATION CATARACTS. David G. Cogan and David D. Donaldson. Arch. Ophthalmol. (Chicago) 45, 508-22(1951) May.

The eyes of rabbits of ages ranging from 3 weeks to 3 years exposed to 200 and 1200 kv x rays showed epilation occurring in 15 to 35 days with doses of 1500 r or greater. Epilation was increased the larger the dose and the less the energy of the x rays. Little variation in susceptibility was found with age. The same generalizations held for kerato conjunctivitis. Cataracts occurred with a latent period that was on inverse function of the dose; the threshold dose for 10-week old rabbits was 250 r or less, and the latent period for the development of radiation cataracts was much less the younger the animal. With x-ray doses (1200 kv) of less than 1000 r, cataracts were the only abnormality produced. Gross and cytological changes due to x-irradiation of the eye are discussed in detail.

6060
ROENTGEN IRRADIATION OF DESOXYRIBONUCLEIC ACID. III. THE RELATION OF DOSE TO DEGREE OF DEPOLYMERIZATION IN VIVO AND THE INFLUENCE OF OXYGEN TENSION. George Limperos. Cancer Research 11, 325-29(1951) May.

The degree of depolymerization of DNA extracted from rat thymus 24 hr after roentgen irradiation in vivo, as measured by the structural viscosity and streaming birefringence of the solutions, was found to be directly proportional to x-ray doses of 250 to 1,000 r.

A reduced oxygen tension (10%) was found to inhibit the depolymerization of DNA, whereas an increased oxygen tension (100%) was found to be relatively ineffective in increasing the depolymerization.

A 10% oxygen tension was found to be less effective than thiourea in preventing the involution of rat thymus tissue induced by roentgen irradiation. (auth)

6061
HISTOLOGICAL AND CHEMICAL ALTERATIONS PRODUCED IN MOUSE EPIDERMIS BY SOFT X-RADIATION. M. H. Toosy. Cancer Research 11, 361-5(1951) May.

Areas of epidermis of the backs of adult, female Swiss Albino mice, approximately 4 to 5 months old, were exposed to soft x-radiation from a Phillips Contact-Cavity therapy machine at a distance of 20 mm, the source of radiation being 50 kv, 2 ma, 100 r per second without a filter. Histological and chemical examinations of the irradiated hyperplastic epidermis were made, and the data so obtained were compared to those relating to normal and methylcholanthrene-treated epidermis.

Histological findings, including the results of cell type determination, revealed only minor difference between irradiated and methylcholanthrene-treated epidermis. However, total calcium of irradiated epidermis was about 30% less than normal, while that of methylcholanthrene-treated epidermis was about 50% less than normal. No difference was noted in the iodine number of lipids of both, as compared to normal epidermis. The total lipids of the irradiated as well as of methylcholanthrene-treated epidermis were nearly the same in both, being significantly less than normal. A polarographic study indicated no difference in a reducible substance from the lipids of irradiated epidermis (between half-wave potentials of unbuffered solution and in buffered solutions at pH 4.40 and at 6.38) compared to those of normal and methylcholanthrene-induced hyperplastic epidermis. (auth)

6062
THE EXPERIMENTAL USE OF BONE MARROW IN ACUTE RADIATION INJURY. John M. Talbot and Ernest A. Pinson. Military Surgeon 108, 412-17(1951) May.

Studies of bone marrow homotransplants in rats whose marrows were depressed by benzene injections and by whole-body x irradiation suggest that the transplants will survive in a reasonably healthy condition for an approximate minimum of 4 weeks. Bone marrow given intramuscularly following acute, whole-body ionizing radiation injury in the lethal and sublethal ranges had no significant effects upon survival, changes in total white blood cell counts, and changes in body weights. Shielding of 1/3 to 3/4 of the hind limbs of rats produced significant differences in survival and weight loss as compared to the transplanted group.

6063
EFFECTS OF EXTERNAL AND INTERNAL RADIATION ON CELL DIVISION. Austin M. Brues and Leola Reitz. Ann. N. Y. Acad. Sci. 51, 1497-1507(1951) Mar.

The effects of radiation upon cell division were studied, using regenerating rat liver. After partial hepatectomy, the liver was exposed to x radiation given in a single dose (10 to 3000 r) injected Pu^{239} and P^{32}, and continuous exposure to a point source of β rays, using small glass beads containing carrier-free Y^{91}. The Y^{91} bead experiment was of most quantitative value in determining the degree of suppression of mitosis. Effects of ionizing radiations on mitosis were shown to include reversible delay in cell division, followed by visible chromosome damage and changes in the mitotic figure. The amount of β radiation required to reduce liver mitosis by one-half was shown to be of the order of 1 rep/hr over a 48-hr period.

6064
CHANGES IN COMPOSITION OF BLOOD PLASMA OF THE RAT DURING ACUTE RADIATION SYNDROME, AND THEIR PARTIAL MITIGATION BY DIBENZAMINE AND CORTIN. Henry I. Kohn. Am. J. Physiol. 165, No. 1, 27-41(1951) Apr. 1.

Adult rats were given a single total-body exposure to 250-kvp x rays, and changes in the plasma were followed for about 30 days. The changes occurred in 2 phases, unaffected by sex, but somewhat dependent upon the strain of rat. The magnitude of the changes varied with the x-ray dose (125 r, 350 r, 650 r), but the timing and sequence did not. During the first phase, occurring in the first 3 to 4 days, sugar and phosphorus rose. During the second phase chloride and cholesterol rose. The changes in other constituents of the blood plasma are discussed quantitatively and the effect of certain drugs is noted. The greatest rate of change in the composition of the plasma occurred during days 3 and 4, the days on which the first deaths occur following a lethal exposure.

6065
THE RELATION OF OXYGEN UPTAKE TO HEMOGLOBIN SYNTHESIS. Jonas E. Richmond, Kurt I. Altman, and Kurt Salmon. Science 113, 404-5(1951) Apr. 13.

Bone marrows of normal rabbits and of rabbits exposed to 800 r of x rays were removed at varying time periods after exposure to radiation. Homogenates were prepared from these marrows and incubated at 38°C in the presence of α-C^{14}-glycine as a hemoglobin precursor. O_2 consumption of the homogenates and the amount of hemin and globin synthesized was determined. The results indicate a difference in the time relation between O_2 consumption and the synthesis of hemin and globin, respectively. Hemin synthesis as well as O_2 consumption increases considerably in homogenates from bone marrows removed immediately after radiation. Furthermore, O_2 consumption and hemin synthesis appear to reach a minimum about 1 week after exposure to radiation at a time when marked degenerative changes prevail in the marrow. Globin synthesis also increases after radiation, but, in contrast to hemin synthesis, it reaches a maximum 48 hr after radiation at a time when O_2 consumption already approaches a minimum value. However, the decay curve of globin resembles in its shape that of O_2 consumption and hemin synthesis. Recovery of all three functions begins 2 to 3 weeks after radiation, which agrees well with histological findings.

6066
RECOVERY FROM RADIATION INJURY. L. O. Jacobson, E. L. Simmons, E. K. Marks, and J. H. Eldredge. Science 113, 510-11(1951) May 4.

An attempt has been made to clarify some of the factors involved in the greatly increased LD_{50} of spleen- or liver-shielded mice (J. Lab. Clin. Med. 34, 740(1949) and 35, 746(1950)). The results indicate that the factor involved in the shielding or transplant experiments is definitely effective after irradiation, and that the factor responsible for recovery from radiation under these conditions is probably a substance of a noncellular nature.

6067
EFFECT OF X-RADIATION UPON SUCCINOXIDASE OF RAT KIDNEY. (18772). M. LeMay. Proc. Soc. Exptl. Biol. Med. 77, 337-9(1951) June.

The succinoxidase system, as well as its component enzymes, the -SH enzyme succinic dehydrogenase, and cytochrome oxidase, were determined in rat kidney homoginates within 2 hr after rats were x-irradiated with 400 or 800 r. No inhibition of any of the enzymes was found. The metabolism of kidney slices from rats given the foregoing amounts of x radiation was studied manometrically with sodium succinate and lithium pyruvate substrates. No statistically significant differences were obtained between the oxidative activities of the kidney slices from the control and irradiated animals. The lack of correlation between certain of the in vivo and in vitro effects of irradiation upon enzyme systems is discussed. (auth)

6068
PHOTORESTORATION FOLLOWING X IRRADIATION OF LYSOGENIC BACTERIA. Raymond Latarjet. Compt. rend. 232, 1713-15(1951) Apr. 30. (In French)

X irradiation of lysogenic B. megatherium with 35,000 r in the exponential growth phase resulted in bacteriophage production and lysis of the culture. An immediate exposure to the light of a 500-w incandescent lamp, filtered through Cu_2SO_4 solution, effected a remarkable restoration of rate of growth.

6069
OBSERVATIONS ON THE SKIN REACTION TO THE SUBCUTANEOUS APPLICATION OF METALLIC POLONIUM IN MICE. By Leiv Kreyberg and Finn Devik. Acta Radiol. 35, 356-62 (1951) May-June.

A nickel plate covered by polonium was introduced under the skin in a series of mice. Some of the polonium was dissolved in the tissue fluid and caused general and local radiation damage. The local changes are described in some detail, and the mechanism of the very marked hyperplasia is discussed. The evidence in favor of the existence of an indirect effect through the connective vascular system is stressed. (auth)

6070
NEGATIVE RESULTS FOLLOWING EXPOSURE OF SEVERAL KINDS OF SEEDS TO COSMIC RAYS AND OTHER RADIATIONS AT HIGH ALTITUDES. J. M. Beal. Botan. Gaz. 112, 533-4(1951) June.

Seed from several species of angiosperms were exposed to cosmic radiations at high altitudes. No mutagenic effects were observed in seedlings grown from these seeds.

6071
POST-RADIATION PARABIOSIS AND SURVIVAL IN RATS. G. Brecher and E. P. Cronkite. Proc. Soc. Exptl. Biol. Med. 77, 292-4(1951) June.

Rats can survive an otherwise fatal dose of radiation if joined after radiation to nonirradiated litter mates. Such rats show accelerated bone marrow regeneration when compared with single controls. It is suggested that post-radiation parabiosis is primarily of benefit because it accelerates recovery of myelopoiesis by the transfer of some cellular or non-cellular material from the non-irradiated partner. (auth)

6072
NUCLEAR AND CELL DIVISION IN ALLIUM CEPA AS INFLUENCED BY SLOW NEUTRONS AND X-RAYS. Ellen Myrberg Rasch. Botan. Gaz. 112, 331-47(1951) June.

Bulbs of Allium cepa were exposed to x-ray dosages of 100, 1000, or 10,000 r, or to slow neutrons having an average flux of 5.8×10^{10} slow neutrons/cm^2/sec for periods of 2, 4, 8, or 16 min. Plants from all irradiated bulbs were markedly retarded in growth. All plants from bulbs irradiated with slow neutrons, or the 10,000 r x irradiation, died. Detailed cytological analysis of damage to root tips of plants from exposed bulbs is reported.

6073
EFFECT OF TOTAL BODY X-IRRADIATION ON GLUTATHIONE LEVELS IN RATS. Ruth D. Peterson, Clarissa H. Beatty, and Edward S. West. Proc. Soc. Exptl. Biol. Med. 77, 747-9(1951) Aug.

A study has been made of blood and liver glutathione in rats after 500 r total body x irradiation. The data show, first, that irradiation generally causes a decrease in blood glutathione; and second, in some cases, a decrease in liver glutathione.

6074
THE INTERACTION OF NUCLEIC ACID AND X-RADIATIONS ON THE CHROMATIN OF RYE AND PEA. Louise R. Sieburth. Northwest Sci. 25, 132-6(1951) Aug.

Rye and pea seeds in the energetic stage were treated with x radiation and/or sodium ribose nucleate. Cells treated with 5000 r showed pycnosis and multinucleoli. The nucleolus had such dense clumping of the chromatin as to be solid in outline. The nucleolus of the rye cells was much larger than in the pea cells, but the nature of the pycnosis of the rye and pea cells was observed to be the same. The material treated with 200 r was similarly affected except that the nucleolus in rye cells showed the chromatin in distinct "bands," whereas pea cells were normal. Normal prophase of mitosis was observed in rye and pea cells treated with nucleate and followed by 200 r. The cells of rye and pea treated with 200 r and followed by nucleate showed different characteristics. In the rye cells, the chromatin was evenly dispersed but was somewhat pycnotic in nature. No nucleolus differentiation was observed. The pea cells on the other hand showed normal granular chromatin, except that the nucleolus showed distinct even clumping of the chromatin.

6075
CYTOLOGIC AND PATHOLOGIC EFFECTS OF IONIZING RADIATION OF INTEREST TO THE VETERINARIAN. John H. Rust. J. Am. Vet. Med. Assoc. 118, 355-62(1951) June.

Cytologic and pathologic effect of ionizing radiation and the effect of nuclear energy upon the organism as a whole are discussed. 39 references.

6076
THE VALUE OF SMALL LEAD SHIELDS AGAINST THE INJURIOUS EFFECT OF TOTAL-BODY IRRADIATION. J. Gershon-Cohen, M. B. Hermel, and J. Q. Griffith, Jr. Science 114, 157-8(1951) Aug. 10.

The effect of shielding of the liver, right lung, or right lower abdomen of young white rats during whole-body irradiation has been investigated. The survival rates of all the partially shielded rats were higher than those exposed to whole-body irradiation. Of 20 rats which received whole-body irradiation, 8 survived. There were 10 survivals of the 12 rats protected over the liver, 7 survivals of 9 rats protected over the right lung, and 6 survivals of 9 rats protected over the right lower abdomen. Survival times, weights, and blood counts are recorded in 7 tables.

6077
EFFECT OF PRETREATMENT WITH CYSTEINE ON SURVIVAL OF MICE EXPOSED TO EXTERNAL AND INTERNAL IRRADIATION. Horace Goldie, Gadson J. Tarleton, Jr., and Paul F. Hahn. Proc. Soc. Exptl. Biol. Med. 77, 790-4(1951) Aug.

Mice pretreated with small doses of cysteine before irradiation with lethal doses of x rays showed a high percentage surviving 10 to 14 days after irradiation. In mice receiving high doses of cysteine the x-ray treatment was

followed immediately by death or agony. The condition of mice treated with one factor alone was affected only after several days indicating a potentiation of treatment with cysteine (high doses) and x irradiation. The effect of high doses of cysteine was absent in x-ray treated mice possessing copious peritoneal exudate due to the growth of free S-37 cells in the peritoneal fluid. This action was attributed to the inactivation (oxidation) of cysteine by some factor of the peritoneal fluid. Pretreatment with small doses of cysteine had unfavorable effects on survival of mice injected with radioactive colloidal gold. A possible explanation offered is the increased cysteine penetration from the blood stream into tissues after increase of blood vessels permeability due to high doses of irradiation.

6078

REDUCTION OF X-RAY SENSITIVITY OF ESCHERICHIA COLI B/r BY SULFHYDRYL COMPOUNDS, ALCOHOLS, GLYCOLS, AND SODIUM HYDROSULFITE. W. T. Burnett, Jr., G. E. Stapleton, M. L. Morse, and Alexander Hollaender. Proc. Soc. Exptl. Biol. Med. 77, 636-8(1951) Aug.

The x-ray sensitivity of E. coli is reduced if the cells are irradiated in the presence of certain chemical agents. Two, 3 dimercaptopropanol (BAL), ethanol, and sodium hydrosulfite increase the dose required to kill a given number of cells in suspensions at 2°C by a factor of 3 to 4. Other sulfhydryl compounds, glycols, and low-molecular-weight alcohols also increase the survival of E. coli suspensions. (auth)

6079

PRODUCTION OF POLYPLOIDS BY COLCHICINE AND X-RAYS. D. Lewis. Nature 167, 891-2(1951) June 2.

X rays have been used to make colchicine more effective in producing tetraploid instead of diploid or chimerical plants. Using 14 small potted plants, 2% colchicine was applied for 48 hr to vegetative shoots of Oenothera organensis in April 1944, followed by x-ray treatment in July 1945. Of the 3 plants exposed to 1000 r, 2 developed 2 tetraploid shoots each; of the 4 plants exposed to 500 r, 1 developed 1 tetraploid shoot; the others remained completely diploid. The x-ray treatment killed more diploid than tetraploid cells. Oenothera plants untreated with colchicine have been subjected to x rays many times without producing any tetraploid tissue. Tests were also made by giving various doses of x-ray treatment to callus tissue of tomato stems which have been cut back. There was no great increase in the proportion of tetraploid shoots. X rays seem to provide a means of overcoming difficulties in production of polyploids in woody plants which fail to respond to colchicine or give chimerical tissue.

RADIATION HAZARDS AND PROTECTION

6080

Atomic Energy Project (Canada)

MEMORANDUM ON THE USE OF DRY BOXES FOR HANDLING ACTIVE MATERIAL (CI-178 Revised, July 1950); by P. B. Aitken. 11p. (CRC-451)

6081

Illinois Univ., Engineering Experiment Station

JET IMPACTORS FOR DETERMINING THE PARTICLE SIZE DISTRIBUTION OF AEROSOLS (Technical Report No. 4); by W. E. Ranz, and J. B. Wong. July 31, 1951. 42p. (SO-1005)

A theoretical and experimental analysis of impactors as instruments for assessing aerosols demonstrates their unusual ability to separate airborne particles into two classes. Larger and heavier particles are thrown onto a collecting surface while smaller and lighter particles escape impaction. Experimental impaction efficiencies for rectangular and round aerosol jets impinging on flat plates are reported with example applications of impactors to the determination of particle size distributions. Designs for two laboratory impactors are shown in detail. (auth)

6082

Hanford Works

THE SECOND ANNUAL REPORT OF THE BOTANY FIELD STATION; J. F. Cline and J. W. Porter. May 1, 1951. 14p. (HW-20999)

Data are presented which show that during 1950 the radioactivity of several types of crops irrigated with water pumped from the Columbia River below the Hanford piles differed but slightly from that of similar crops grown in a control area. (auth)

6083

Naval Radiological Defense Lab.

YOUR GUIDE TO RADIOLOGICAL SAFETY. Paul C. Tompkins, Director. [nd] 16p. (NP-3332)

This is a pocket-size pamphlet giving safety rules for the scientist who is working with radioactive materials.

6084

Naval Radiological Defense Lab.

THREE KEYS TO RADIOLOGICAL SAFETY. Paul C. Tompkins, Director. [nd] 15p. (NP-3333)

This is a pocket-size pamphlet giving safety rules for the nonscientific laboratory worker who is working in a laboratory where radioactive materials are used.

6085

HISTORICAL SKETCH OF RADIATION PROTECTION EXPERIENCE AND INCREASING SCOPE OF RADIATION PROTECTION PROBLEMS. K. Z. Morgan. Ind. Med. Surg. 20, 148-56(1951) Apr.

The need for a science of health physics and the duties of health physicists are outlined in a nontechnical manner. Several photographs illustrate measures taken for protection from radiation, and typical exposure records are shown on graphs.

6086

OBSERVATIONS ON RADIOACTIVE SNOWS AT ANN ARBOR, MICHIGAN. W. Wayne Meinke. Science 113, 545-6(1951) May 11.

Rigorous chemical separations performed on radioactivities found in snows around Ann Arbor, Michigan, after the Las Vegas atomic test explosions of Jan. 27 to Feb. 6, 1951, have definitely established the presence of radioactive rare-earth isotopes and Ba and/or Sr isotopes and have shown the possible presence of I isotopes. The tests conducted on the samples are described. Because of the chemical distribution of the activities found in the Ann Arbor snows, these activities undoubtedly originated in the Las Vegas atomic test explosions.

6087

ATMOSPHERIC POLLUTION. Louis C. McCabe. Ind. Eng. Chem. 43, No. 6, 105A-108A(1951) June.

A method of incineration has been developed by the U. S. Bureau of Mines (R. C. Corey et al., Am. Ind. Hyg. Assoc. Quart. (in press)) whereby all residues are fluxed in a molten compound as an integral step in the operation of the incinerator. Sodium hydroxide has been found to meet the basic requirements for a flux for such typical ashes as those that result from the incineration of wood, paper, cloth, and bone. Since the rate of corrosion of ordinary carbon steel and molten sodium hydroxide at 1000°F is relatively low, inexpensive steel containers can be used to retain the molten flux and can be disposed of when saturated with ash. All insoluble constituents in the ash are converted to soluble sodium salts, suggesting possible reclamation of certain radioisotopes. Also reported is an automatic sampler designed to collect particulate matter in the air at set time intervals for comparison purposes. In addition to pro-

viding data on pollution levels, the samples are adequate for determination of particulate matter.

6088
A PHOTOGRAPHIC FILM DOSIMETER. Natl. Bur. Standards (U.S.), Tech. News Bull. 35, 98-9(1951) July.

A compact film badge dosimeter designed to monitor γ and x radiation in the quantum energy range from 120 kev to about 10 Mev is described. Film badges calibrated with x-radiation energies from 115 kev to 10 Mev showed accuracy limits within the ranges from 1 to 40 roentgens and from 500 to 10,000 roentgens to be $\pm 12\%$. In the center range, from 50 to 500 roentgens, the resulting limits were $\pm 20\%$.

6089
THE STUDY OF DUSTS IN INDUSTRIAL ATMOSPHERES. 3—THE IMPINGER AND CASCADE IMPACTOR. P. F. Holt. Metallurgia 43, 258-9(1951) May.

The principle and efficiency of the impinger as a means of estimating dust-particle counts are discussed briefly. The most recently introduced apparatus for this purpose is the cascade impactor, which is similar to the konimeter in that the sample is collected by forcing the air through a narrow jet to impinge on a glass slide coated with a suitable adhesive, but in the impactor the air must pass consecutively through four jets, each of smaller size than the last. The size and shape of each jet of the impactor are given. Size segregation in sampling is illustrated by tests made with heterogeneous spray clouds. It was found that all particles larger than 20 μ were collected on the first slide; those larger than 7 μ were found on the second; while particles larger than 2.5 μ were absent from the last slide.

6090
INVESTIGATION OF SMALL, AIRBORNE, CHARGED PARTICLES BY AN ELECTRICAL METHOD. J. H. Daniel and F. S. Brackett. Arch. Ind. Hyg. Occupational Med. 3, 505-19(1951) May.

Using a method they describe elsewhere (J. Applied Phys., to be published) the authors have continued their study of the physical characteristics of aerosol particles and their relation to the various mechanisms (aggregation, diffusion, settling) through which particles disappear from the aerosol. The experimental data are analyzed by means of a charge-weighted distribution of r^3/e or r/e by which particles are compared with regard to their rate of disappearance. Aerosols of silica, NaCl, and "residual" particles formed by incidental stirring up of dust and evaporation of distilled water aerosol are compared.

6091
A METHOD OF OBTAINING REPRODUCIBLE BREATH RADON SAMPLES. John H. Harley, M. S. Evelyn Jetter, and Merril Eisenbud. Arch. Ind. Hyg. Occupational Med. 4, 1-9(1951) July.

A method is reported of breath sampling, for determination of radon in the breath, in which compressed air and a simple respirator are used to provide a radon-free atmosphere for the subject to breathe. The air supply is a tank of washed compressed air that is at least one month old (to allow for decay of any radon present). The use of the respirator does not give a "normal" breathing pattern but induces the reproducible rate and depth that are important in obtaining a representative sample.

6092
HIGH EFFICIENCY COLLECTION OF RADIOACTIVE DUST. K. J. Caplan. Heating and Ventilating 48, 79-82(1951) Feb.

The results of practical experience in dust collection at one atomic energy installation are presented. Data are given for applications involving medium and high grain loadings where the air-filter type of equipment would not be suitable. Efficiencies up to 99.998% at air-to-bag ratios of 27 cfm/ft^2 have been achieved using the Hersey reverse jet principle. Other types of dust collectors are discussed.

6093
ROENTGEN HYGIENE. Ragnar Steinert. Nord. Med. 46, 1165-7(1951) Aug. 1. (In Norwegian)

The protective effect of Roentgen gloves with a lead equivalent of 0.2 to 0.5 was measured by placing chambers of 5 mr sensitivity and 300 mr capacity inside the gloves. Only gloves of 0.5 lead equivalent completely protected the physicians' hands in routine x-ray examinations in which 70 kv and 3 to 4 mr were used in each experiment. With hands unprotected, the permitted daily tolerance dose was exceeded in a relatively short time.

6094
THE EFFECT OF SHIELDING ON MORTALITY FOLLOWING IRRADIATION. Herbert L. Abrams, M. D., and Henry S. Kaplan, M. D. Stanford Med. Bull. 9, 165-6(1951) Aug.

Lead shields placed over the head, chest, abdomen, or thighs during irradiation conferred a significant degree of protection on mice of all four groups as compared with unshielded controls. Protection was most striking when the abdomen was shielded. (auth)

RADIATION SICKNESS

6095
DIAGNOSIS OF RADIATION INJURY AS PRODUCED BY ATOMIC BOMBS. Eugene P. Cronkite. Med. Ann. Dist. Columbia 20, (1951) May.

This is a nontechnical summary of radiation injuries to be expected after an atomic bomb blast. The author divides radiation injuries into superficial burns from β rays and the "syndrome of acute radiation injury." He describes the 5 phases of the first type, and divides casualties of the second type into 3 groups, according to chances for survival.

RADIOGRAPHY

6096
A NEW APPROACH TO HIGH RESOLUTION RADIOAUTOGRAPHY. R. M. Fink. Science 114, 143-9(1951) Aug. 10.

A thin thyroid section containing I^{131} was placed between two slightly flattened lead balls and the two balls were then squeezed in a small hydraulic press, on the theory that each part of the tissue would be tightly held by the pressure from the lead atoms above and below and that as the lead atoms began to flow outward the tissue might expand with the lead. A radioautograph of the inside surface of each disk showed a magnified outline of the gross histological structures of the thyroid section, with a clarity at least as good as that of the original radioautograph. If, instead of a ball, the tissue is covered with lead foil that will be quite thin after expansion the radioautographic film can be exposed right through the thin lead covering.

6097
SOME OBSERVATIONS ON TRACK AUTORADIOGRAPHS OF BIOLOGICAL SPECIMENS. Hilde Levi. Biochem. et Biophys. Acta 7, 198-206(1951) July.

The application of α autoradiography in the study of biological specimens containing thorium and its decay products is described. The experimental procedure is outlined, and various artefacts and necessary corrections are discussed. (auth)

RADIOTHERAPY

6098

THE APPLICATION OF RADIOACTIVE COLLOIDAL GOLD IN THE TREATMENT OF PELVIC CANCER. Alfred I. Sherman, MacDonald Bonebrake, and Willard M. Allen. Am. J. Roentgenol. Radium Therapy 66, 624-38(1951) Oct.

Radioactive gold, Au^{198}, suspended in pectin solution was used interstitially alone and in conjunction with radium preoperatively in the treatment of carcinoma of the cervix uteri. It was also injected into the inguinal region previous to resection of these lymph nodes in carcinoma of the vulva. The radioactive gold was found to enter the lymphatic system and reach the regional lymph nodes. There were definite irradiation effects noted both in the parametrium and in the corresponding lymph nodes.

6099

A NEW METHOD FOR THE TREATMENT OF CANCER OF THE LUNGS BY MEANS OF ARTIFICIAL RADIOACTIVITY. (Zn^{65} AND Au^{198}). J. H. Muller and P. H. Rossier. Acta. Radiol. 35, 449-68(1951) May-June.

The clinical development of selective fixation of artificial radioactivity within the lungs is shown. Au^{198} in the form of a precipitate, with particle size 30 to 50 μ in a pectin-containing solution with the addition of heparinized blood of the patient is used instead of Zn^{65}, which has a much shorter half-life period than Au^{198}. By intravenous injection diffuse microemboli in the lung tissue are obtained. Through a heart catheter inserted into a selected pulmonary artery the radioactivity can be localized in the corresponding part of the lung—up to 150 mc have been injected. This new therapeutic procedure was carried out in 2 patients with Zn^{65} and in 4 patients with Au^{198} (1 case of pulmonary metastases of a hypernephroma, 1 case of pulmonary lymphogranuloma, and 4 cases of inoperable bronchial carcinoma). The method may be combined with intrapleural or intratumoral injections of colloidal Au^{198} as well as with classical radiotherapy or surgical operations. (auth)

6100

DIFFERENTIATION OF MEDIASTINAL TUMORS BY CINE-FLUOROGRAPHIC AND RADIOACTIVE IODINE (I^{131}) STUDIES. F. Ross Birkhill, K. E. Corrigan, and H. S. Hayden. Harper Hosp. Bull. 9, 70-4(1951) June.

Use of I^{131} as a tracer and use of intravenous injection of radio-opaque medium as diagnostic procedures, alone or in combination, are shown to be useful in determining the origin of tumors in the mediastinum.

6101

STRAY RADIATION FROM DIAGNOSTIC X-RAY BEAMS. B. E. Keane and G. Spiegler. Brit. J. Radiology 24, 198-203(1951) Apr.

The results of measurements of quantity and quality of scatter outside the patient from 60 to 100 kv diagnostic x rays are presented. Scattered doses, expressed in terms of dose per incident roentgen, for various incident qualities, are presented as functions of the cross section of the beam, and the thickness of the layer of tissue between the primary beam and the observer. Side-scatter radiation outside the patient has been found to be harder than the incident radiation for diagnostic beam. The factors influencing scatter are discussed. An approximate mathematical theory is developed from Mayneord's (Brit. J. Radiology 13, 242(1940)) integral dose considerations.

TOXICOLOGY STUDIES

6102

THE EPIDEMIOLOGY OF BERYLLIUM INTOXICATION. James H. Sterner and Merril Eisenbud. Ind. Health Monthly 11, 104-5(1951) July.

Environmental, epidemiological, clinical, and pathological characteristics of Be intoxication are described. The specific characteristics by which the disease manifests itself are explained by a hypothesis that the essential mechanism of the disease is a modified immunological reaction.

6103

PRECAUTIONS NECESSARY TO SAFE HANDLING OF BERYLLIUM IN MANUFACTURE OF BERYLLIUM WINDOW X-RAY TUBES. E. Beyer. Cathode Press 8, No. 3, 18-21(1951)

Steps taken at Machlett Laboratories, Springdale, Conn., to prevent berylliosis are enumerated. Under earlier uncontrolled conditions atmospheric concentrations of Be ranged from 1.1 to 318 $\mu g/m^3$ of air. Control measures, including adequate mechanical exhaust ventilation and provision of respiratory protective equipment during general maintenance procedures, have reduced the level of exposure to well below 1 $\mu g/m^3$ of air.

6104

BERYLLIUM EXCRETION IN HUMANS. F. W. Klemperer, A. P. Martin, and J. Van Riper. Arch. Ind. Hyg. Occupational Med. 3, 251-6(1951) Sept.

The urinary excretion of beryllium of patients with pulmonary granulomatosis, as well as of healthy workers in the beryllium industry, and of unexposed individuals, was determined. Beryllium was not detected in the urine of 35 persons who had not had occupational exposure to beryllium. Of 20 patients with chronic pulmonary granulomatosis, only 12 excreted detectable amounts of beryllium. Their daily excretion was found to be nearly constant during the experimental period. Beryllium was detected in the urine up to 10 yr after cessation of exposure. In the urine of healthy beryllium workers, the amount of beryllium was comparable to that found in the urine of patients with pulmonary granulomatosis who had worked in similar industries. The excretion of beryllium appears to depend on the solubility of the inhaled material. The highest excretions were found in persons exposed to soluble beryllium. The diagnostic significance of urinary beryllium determinations and their value as a quantitative index of industrial exposure are discussed. (auth)

TRACER APPLICATIONS

6105

Sloan-Kettering Inst. for Cancer Research

ON THE ROLES OF PURINES AND PURINE PRECURSORS IN THE FORMATION OF THE NUCLEIC ACIDS. Aaron Bendich. [nd] 20p. (AECU-1611)

Studies, the literature on which is reviewed, on the incorporation of adenine, guanine, and thymine in pentose (PNA) and desoxypentose (DNA) nucleic acids have led to the question of whether two kinds of DNA exist, one biochemically stable, the other labile, or whether DNA has a heterogeneous structure, the parts of which turn over at different rates. Using a new method of fractionating tissue nucleic acids, the author has separated the DNA_1 (insoluble in cold 0.87% NaCl), DNA_2, and PNA nucleotides from regenerating liver of rats partially hepatectomized and intraperitoneally injected with C^{14}-formate. There was a 30% greater incorporation of isotope into the DNA_2 thymine than into the DNA_1 thymine; the incorporation of isotope into the DNA_2 adenine was 23% greater than into that of DNA_1. In contrast, the DNA_1 guanine activity was 25% greater than the DNA_2 guanine. There was a difference in turnover between the two DNA's when the extent of retention of isotope in the guanine moieties was compared. These results indicate that a piecemeal or partial biosynthesis of DNA is a possibility, and imply that these

large-molecular-weight substances might be synthesized in a manner different from that suggested for proteins.

6106
METABOLISM OF CALCIUM IN NORMAL, RACHITIC, AND VITAMIN D-TREATED RATS AS EVIDENCED BY RADIOCALCIUM Ca^{45} STUDIES. Elizabeth Underwood, Salomon Fisch, and Harold C. Hodge. Am. J. Physiol. 166, 387-93 (1951) Aug. 1.

Results indicate that vitamin D in rachitic rats increases the absorption of calcium from the gastrointestinal tract, aids in mobilizing inorganic phosphorus from organic sources, and locally accelerates the mineralization of bone. Active healing of rachitic bone, as shown by the upswing in the curve of deposition of Ca^{45}, begins between the 48th and 72nd hour after the administration of the vitamin. (auth)

6107
COMPARISON OF A SINGLE G-M TUBE METHOD AND A MULTITUBE METHOD OF ASSAYING I^{131} UPTAKE BY THE HUMAN THYROID. Martin Perlmutter, Shirley Weisenfeld, and Monroe Mufson. J. Clin. Endocrinol. 11, 1012-20(1951) Sept.

The efficacy of a single G-M tube and a four-tube multicounter method in assaying the I^{131} content of the human thyroid gland were compared. The mean error of triplicate readings by the single-tube method was 3.3% compared to a mean error of 5.4% by the multitube method. It was concluded that the single G-M tube method is satisfactory, provided sensitive γ-counting tubes are used and the distance between the tube and the patient's neck is not less than 30 cm.

6108
THE FIXATION OF RADIOACTIVE DIGITOXIN BY ISOLATED HEARTS. A. Sjoerdsma and C. S. Fischer. Circulation 4, 100-04(1951) July.

The nature of digitoxin fixation in isolated hearts was studied with C^{14} labeled digitoxin. Fixation was greatest in the early stages of perfusion. The amount of drug fixed was measured directly. A considerable percentage of the digitoxin in cardiac muscle was changed to other substances. These substances are more firmly bound to the heart than digitoxin. (auth)

6109
DISTRIBUTION OF RADIOACTIVE COLCHICINE IN SOME ORGANS OF NORMAL AND TUMOR-BEARING MICE. A. Back, E. Walaszek, and E. Uyeki. Proc. Soc. Exptl. Biol. Med. 77, 667-9(1951) Aug.

To investigate the accumulation of colchicine in tumor tissue and to ascertain whether the presence of tumors in mice brings about changes in the distribution pattern of colchicine, radioactive colchicine labeled with C^{14} was injected into mice. Sarcoma 180 was then implanted. Labeled colchicine was detected only in some organs of normal and tumor-bearing mice, and the uptake of colchicine in sarcoma 180 was as high as the uptake of liver. Spleen had a high concentration of colchicine in normal mice but no colchicine in tumor-bearing mice.

6110
PREFERENTIAL INCORPORATION OF FORMATE CARBON INTO LEUKEMIC BLOOD CELLS AS INDICATED BY AUTORADIOGRAPHY. Howard E. Skipper, Juanita B. Chapman, George A. Boyd, William H. Riser, Jr., and Martelia Bell. Proc. Soc. Exptl. Biol. Med. 77, 849-54 (1951) Aug.

One hour after injection of 100μc of C^{14}-sodium formate into mice with advanced Ak-4 leukemia, it was shown by means of blood smear autoradiograms that about 90% of the prolymphocytes (leukemic cells) are highly active as compared to about 5% of the more mature lymphoid elements. No active polymorphonuclears, erythrocytes, or thrombocytes were observed within 1 hr.

CHEMISTRY

6111
Southern Calif. Univ.
STUDIES ON AMINOBORON COMPOUNDS; FIRST ANNUAL SUMMARY REPORT OF INVESTIGATIONS ON WATER-REACTIVE CHEMICAL COMPOUNDS. Anton B. Burg, C. Lowell Randolph, Jr., Theodore E. Steinberg, George W. Campbell, Jr., and Arthur J. Stosick. Nov. 1, 1947. 20p. (NP-3342)

6112
Southern Calif. Univ.
STUDIES ON AMINOBORON COMPOUNDS; SECOND ANNUAL SUMMARY TECHNICAL REPORT OF INVESTIGATIONS ON WATER-REACTIVE CHEMICAL COMPOUNDS. Anton B. Burg, C. Lowell Randolph, Jr., George W. Campbell, Jr., Ernest S. Kuljian, and Arthur J. Stosick. Nov. 1, 1948. (NP-3341)

6113
Brookhaven National Lab.
CHEMISTRY, p.31-43, 49-61, 63-8 of QUARTERLY PROGRESS REPORT; APRIL 1–JUNE 30, 1951. Issued Aug. 1951. 32p. (BNL-117(p.31-43, 49-61, 63-8))

Reports in various stages of preparation for publication are presented on decomposition of H_2O_2 by high-energy x rays, exchange between the tris-(5,6-dimethyl-1,10-phenanthroline) complexes of Fe(II) and (III), reaction of nitrous acid with hydroxylamine, acetolysis rates of the cis- and trans-2-chloro- and 2-bromocyclohexyl p-bromobenzenesulfonates, preparation of radioactive vitamin B_{12} by direct neutron irradiation, formation of iodine and olefin compounds in solutions at low temperatures, recovery of Pa from U ore residues, r-f volumetric titrimetry, and preparation of borax enriched in B^{10}.

6114
Oak Ridge National Lab.
PHYSICAL BEHAVIOR OF THE H_2-O_2-H_2O SYSTEM UNDER PRESSURE; by J. M. Smith and D. L. Katz. Issued Sept. 24, 1951. 62p. (ORNL-1069)

The solubilities of H_2, O_2, and a $2H_2$:$1O_2$ mixture in water and salt solutions have been correlated over the range of temperature from 25 to 300°C and of pressure from atmospheric to 2,000 psi. Discussions and correlations are presented on the water vapor concentration in the gas phases, the relative volatilities of several gases in water, and the temperature changes upon adiabatic expansion of saturated vapors of these systems. (auth)

6115
Oak Ridge National Lab.
THE NOMENCLATURE OF ORGANIC COMPOUNDS CONTAINING ISOTOPIC CARBON; by Clair J. Collins, Charles E. Crompton, Anthony R. Ronzio, and Bert M. Tolbert. Issued Oct. 1, 1951. 22p. (ORNL-1084)

After discussing the problems involved in nomenclature of labeled compounds and the present lack of uniformity in the literature, the authors outline a nomenclature guide based on established principles and good usage. Numerous examples are given.

6116

Brookhaven National Lab.

EXPERIMENTS ON COMPOUND FORMATION IN SOLUTIONS AT LOW TEMPERATURES; IODINE AND OLEFINS; by Simon Freed and Kenneth M. Sancier. [nd] 19p. (AECU-1636)

The brown solutions of I_2 in aromatic hydrocarbons differ from the purple solutions in saturated hydrocarbons by possessing in each instance a strong absorption band in the ultraviolet region. This band has been recognized as arising from a 1:1 molecular addition compound of the I and hydrocarbon. Similar addition compounds have now been found between I and olefins. The ultraviolet absorption, characteristic of the addition compound, was present in the spectra of solutions of I and in the following hydrocarbons: propene, cis-2-butene, trans-2-butene, 1,3-butadiene, and 2-methyl-1,3-butadiene, either pure or mixed with propane at temperatures from 77 to 230°K. Cyclopropane and I also possess, at somewhat shorter wavelengths, the characteristic strong absorption band representing the addition compound, in agreement with some double-bond character attributed to cyclopropane. The addition compounds form reversibly. At higher temperatures a reaction occurs consuming I, probably the well-known halogenation of the double bond. This takes place slowly with propene at 230°K and rapidly with 2-methyl-1,3-butadiene at 150°K. Energy of activation was found necessary for the formation of the addition compound. Heats of formation of the addition compounds vary roughly from 200 to 500 cal/mole. The nature of the bond in these compounds is discussed. (auth)

6117

Knolls Atomic Power Lab.

THE VAPOR PRESSURE OF LIQUID MERCURY FROM THE TRIPLE POINT TO THE CRITICAL POINT; by Leo F. Epstein and Marion D. Powers. [nd] 11p. (AECU-1640)

An equation for the vapor pressure of liquid Hg which should be valid from the triple point to the critical point has been derived as follows: $\log_{10}p(\text{atm}) = A + (B/\theta) + C\log_{10}\theta + D\theta + E\theta^2 + F\theta^3 + G\theta^4$ where $A = +8.372268$, $B = -3337.8142$, $C = -1.153093$, $D = +2.98647 \times 10^{-4}$, $E = -8.84088 \times 10^{-8}$, $F = -8.84868 \times 10^{-12}$, $G = +3.13504 \times 10^{-14}$, and θ is the temperature in degrees Kelvin. The estimated absolute accuracy of the equation is ±1.5% at −39°C, ±0.03% at 357°C, and ±5.0% at 1460°C. Results are compared with those of Douglas, Ball, and Ginnings of the National Bureau of Standards.

6118

CRYOSCOPY OF SEVERAL OXIDES IN MOLTEN CRYOLITE. Eugène Darmois and Georges Petit. Compt. rend. 232, 1555-6(1951) Apr. 23. (In French)

The cryoscopic depressions caused by dilute (0 to 0.04M) solutions of ThO_2, CeO_2, ZrO_2, SnO_2, UO_2, and La_2O_3 in molten cryolite have been measured. ThO_2 is completely dissociated into three particles, presumably the metal ion and two O^{--}, while CeO_2, ZrO_2, SnO_2, and UO_2 tend toward this condition at zero concentration. In very dilute solution, La_2O_3 shows five-particle dissociation, which changes rapidly to three-particle with slightly increased concentration. A two-step dissociation is indicated: $La_2O_3 \rightleftharpoons LaO_2^- + La^{+3} + O^{--}$; $LaO_2^- \rightleftharpoons La^{+3} + 2O^{--}$.

6119

ISOTOPIC EXCHANGE BETWEEN METAL IONS OF DIFFERENT VALENCY. Joseph Weiss. J. Chem. Phys. 19, 1066-7(1951) Aug. (Letter to the editor)

Two reversible oxidation-reduction mechanisms are discussed for isotope-exchange reactions with metal ions in different states of valency. The operation of any particular mechanism will depend on the redox potentials of the systems under consideration. Possible exchange mechanisms in aqueous solutions and in the presence of O_2 are tabulated for Cr^{+2}/Cr^{+3}, Ti^{+2}/Ti^{+3}, V^{+2}/V^{+3}, Cu^{+}/Cu^{+2}, $Fe(CN)_6^{-4}/Fe(CN)_6^{-3}$, Fe^{+2}/Fe^{+3}, Mn^{+2}/Mn^{+3}, Ce^{+3}/Ce^{+4}, and Co^{+2}/Co^{+3}. Exchange is only to be expected in those cases where the net rate of the irreversible chemical process is low, as for the exchange process the predominance of the reversible steps is essential.

6120

CHEMICAL INVESTIGATIONS OF PROTACTINIUM. I. EXISTENCE AND PROPERTIES OF TETRAVALENT PROTACTINIUM. M. Haïssinsky and G. Bouissières. Bull. soc. chim. France (5) 18, 146-8(1951) Jan.-Feb. (In French)

Compounds of Pa(V) in acid are reduced by Zn amalgam or chromous salts to the tetravalent state. The analytic characteristics of Pa(IV) are described. Pa(IV) fluoride, phosphate, hypophosphate, iodate, phenylarsinate, and double sulfate with K_2SO_4 are slightly soluble. Soluble complexes are formed with ammonium carbonate, Na citrate, and Na tartrate.

ANALYTICAL PROCEDURES

6121

Atomic Energy Project (Canada)

THE DETERMINATION OF MICROGRAM AMOUNTS OF BORON IN CALCIUM AND MAGNESIUM METALS; by H. A. Bewick, F. E. Beamish, and J. C. Bartlet. Feb. 20, 1946. 10p. (MX-228)

6122

Columbia Univ. and Sloan-Kettering Inst. for Cancer Research

STUDIES ON THE STRUCTURE OF NUCLEIC ACIDS V; ON THE MECHANISM OF METAL AND ENZYME INTERACTIONS; by Liebe F. Cavalieri. [nd] 26p. (AECU-1613)

Changes in the ultraviolet absorption spectrum of desoxypentose nucleic acid are brought about both by changes in pH and by the addition of Mg ions. It is concluded that the effect caused by Mg ions is due to alterations in the macromolecular structure of the nucleic acid. Evidence is presented which indicates that Mg^{++} attaches both to phosphate and nuclear amino groups. Inhibition of desoxyribonuclease action by citrate ions, as observed spectrally, does not involve removal of Mg^{++} from the desoxyribonucleic acid. Enzyme-substrate complexes of yeast pentose nucleic acid and ribonuclease have been studied. The formation of complexes probably involves interaction at the ionized phosphate groups, of which there appear to be at least two types. It has been shown that mononucleotides interact with pentose nucleic acid. From the results of the effect on complex formation it is tentatively suggested that inhibition of ribonuclease action by nucleotides occurs during intermediate stages. (auth)

6123

COLORIMETRIC DETERMINATION OF LITHIUM. A. V. Nikolaev and A. A. Sorokina. Doklady Akad. Nauk S.S.S.R. 77, 427-8(1951). (In Russian)

Li can be determined colorimetrically with the aid of Kuznetsov's reagent which is 1-(2-arsonophenylazo)-2-hydroxy-3,6-disulfonaphtalene mixed with KOH and sodium stearate (Kuznetsov, Zhur. Anal. Khim. 3, 295(1948)). While large quantities of Na and K do not affect the color, Ca and Mg interfere with it and should be removed. The method can be used in daylight only.

6124
ZIRCONIUM FOR SODIUM PEROXIDE FUSIONS. G. J. Petretic. Anal. Chem. 23, 1183-4(1951) Aug.

Sodium peroxide fusion of ores over an open flame has been successfully carried out in Zr crucibles. Fusions are quickly made, no temperature control has been necessary, and Zr crucible is only slightly attached. Fusions have been carried out more than 20 times in the same crucible without showing an appreciable attack.

6125
DETERMINATION OF TITANIUM IN ROCKS AND MINERALS. R. P. Graham and J. A. Maxwell. Anal. Chem. 23, 1123-6(1951) Aug.

The procedures described were developed to provide a method for the determination of titanium in rocks and minerals that is free of some of the disadvantages of the conventional colorimetric method. After electrolysis of a solution of the sample in a mercury cathode cell to remove iron and other interfering ions, titanium is determined polarographically. The supporting electrolyte, 1.0M in tartaric acid and 0.5M in sulfuric acid, permits the recording of a well-formed polarographic wave, the height of which is directly proportional to the concentration of titanium in the solution. Of the foreign elements not removed in the mercury cathode cell, only uranium interferes with the subsequent polarographic procedure. The method is of good precision and yields values in close agreement with those given by the colorimetric method using hydrogen peroxide. Although not as sensitive as the colorimetric method, it is less subject to errors arising from foreign ions and is in certain respects more convenient. (auth)

6126
VOLUMETRIC DETERMINATION OF FLUORINE WITH ZIRCONIUM CHLORIDE SOLUTION. H. v. Zeppelin. Angew. Chem. 63, 281-2(1951) June 21. (In German)

A rapid method for the analysis of fluoride solutions by titration with $ZrCl_4$ using Na-alizarinsulfonic acid as indicator is described. This is an improvement of the method of de Boer and Basart (Z. anorg. u. allgem. Chem. 152, 213(1926)).

6127
DETERMINATION OF TITANIUM(III) IN TITANIFEROUS SLAGS. L. E. MacCardle and E. R. Scheffer. Anal. Chem. 23, 1169-70(1951) Aug.

If the Ti(III) and Fe(II) can be oxidized under controlled conditions with complete solution of the sample, accurate analyses can be performed. In this procedure the Ti(III) and Fe(II) react with the standardized vanadium pentoxide immediately upon being dissolved, in accordance with the following equation: $Ti^{+3} + Fe^{++} + 2V^{+5} \rightarrow Ti^{+4} + Fe^{+3} + 2V^{+4}$. The addition of hydrofluoric acid permits complete solution without interference with the analysis. The excess vanadium pentoxide is determined by titration with standard ferrous ammonium sulfate. The Fe can be determined by any conventional method, and the amount of Ti(III) calculated.

6128
RADIOACTIVITY IN CHEMICAL ANALYSIS. Pascaline Daudel. Anal. Chim. Acta 5, 426-44(1951) Aug. (In French)

Various methods of analysis which make use of radioactivity are described and illustrated. These include the method of direct activation (determination of Mn in an Al alloy), use of exchange reactions (determination of a mixture of chlorides, bromides, and iodides), determination making use of the transparency to neutrons (e.g., determination of boron in boron carbide), determination by means of a radioactive reagent (analysis of amino-acid mixtures), dilution method (determination of potassium), etc.

6129
ON THE THERMOGRAVIMETRY OF ANALYTICAL PRECIPITATES. LI. DETERMINATION OF ZIRCONIUM. Janine Stachtchenko and Clement Duval. Anal. Chim. Acta 5, 410-21(1951) Aug. (In French)

With the help of the Chevenard thermobalance, the authors have traced the thermolysis curves of precipitates proposed for the determination of Zr. The methods in which picric acid, potassium iodate, ammonium arsenate, and oxine are used have been rejected; those in which ammonia, aniline, diethylaniline, and in particular mandelic acid are used are recommended for the automatic determination of Zr. Zr hydroxide can be prepared in a pure state by means of aniline, while various other reagents afford zirconyl hydroxide. The problem of reduction of Zr by pyrolysis of its As(V) derivatives has not been solved. (auth)

6130
METHODS OF FLUORINE AND FLUORIDE ANALYSIS—III. F. E. McKenna. Nucleonics 9, No. 2, 51-8(1951) Aug.

Literature published during the period 1816 to 1950 has been reviewed to provide this annotated bibliography. The pertitanic acid and fluosilicic acid methods are discussed, the analysis of fluorocarbons, volatile fluorides, and elemental F are considered, and spectrochemical methods, and determination of fluorides in specific substances, such as foods, biological and industrial materials, are treated briefly. 516 references.

6131
QUANTITATIVE ANALYSIS OF POTASSIUM-CONTAINING SALTS AND SOLUTIONS, BASED ON THEIR NATURAL RADIOACTIVITY. O. Gübeli and K. Stammbach. Helv. Chim. Acta 34, 1245-53(1951) Aug. 1. (In German)

Natural β and γ activity of K^{40} is utilized for the quantitative determination of K, using finely pulverized samples in layers 0.6 g/cm² or 0.09 g/cm² thick and a counter with a 2-mg/cm² mica wall. In solutions, K is determined by submerging the counter; 0.05N K solutions can be accurately measured using 21.5 cm³ of liquid. (auth)

6132
DETERMINATION OF BORON IN METAL BORIDES. Herman Blumenthal. Anal. Chem. 23, 992-4(1951) July.

In the search for a method that could be used for the determination of boron in metal borides, it was found that the standard procedure of separating boron in the form of methyl borate from the metals by distillation was too time-consuming and not always accurate. The method described carries this separation out by precipitating the metals with barium carbonate after using a sodium carbonate fusion to bring the sample into solution. It has been successfully applied to the borides of iron, chromium, tungsten, titanium, zirconium, thorium, vanadium, niobium, tantalum, calcium, cerium, and aluminum, boron carbide, boron nitride, and amorphous and electrolytic boron. The borides of transition metals have recently become of great interest because of their physical properties at high temperatures. This method should therefore be useful for fast and accurate routine determinations. (auth)

6133
METHODS OF FLUORINE AND FLUORIDE ANALYSIS—II. F. E. McKenna. Nucleonics 9, No. 1, 40-9(1951) July.

Literature published during the period 1816 to 1950 has been reviewed to provide this annotated bibliography. The topics covered are determination of F by formation of ThF_4, by formation of ZrF_4 and lakes of Zr with 1,2-dihydroxyanthraquinones, and by volatilization as SiF_4 or fluosilicic acid.

6134
ISOTOPIC DETERMINATION OF NITROGEN AND CARBON; BY MEANS OF A MICROWAVE SPECTROGRAPH. A. L. Southern, H. W. Morgan, G. W. Keilholtz, and William V. Smith. Anal. Chem. 23, 1000-4(1951) July.

Research on the use of a microwave spectrograph for isotopic analyses was undertaken as part of a program of the Oak Ridge National Laboratory to develop new methods of isotope assay. Analytical procedures have been developed for nitrogen 15 in ammonia and for carbon 13 in cyanogen chloride, as being typical of the stable tracer isotopes. Nitrogen 15, in the range 0.38 to 4.5%, can be determined to within approximately 3% of its concentration. For carbon 13, in the range 1.1 to 10%, the average error is less than 2% of the concentration. For each element, samples of known enrichment must be examined to determine a standard curve. A complete analysis requires 0.00015 mole of gas, the major portion of which may be recovered. The microwave spectrograph can be used for analysis of isotopes of many of the lighter elements with an accuracy comparable to that for nitrogen and carbon. Accuracy, sample requirements, and characteristics indicate application to both routine and special analyses. (auth)

6135
SEPARATION AND DETERMINATION OF TETRAVALENT AND PENTAVALENT VANADIUM. André Morette and Guislain Gaudefroy. Bull. soc. chim. France (5) 18, 73-6 (1951) Jan.-Feb. (In French)

A preliminary account of the investigation was given in Compt. rend. 231, 408-10(1950) and abstracted in Nuclear Science Abstracts as NSA 5-53.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

6136
ANOMALOUS MIXED CRYSTALS IN THE $ThO_2-La_2O_3$ SYSTEM. F. Hund and W. Dürrwächter. Z. anorg. u. allgem. Chem. 265, 67-72(1951) June. (In German)

Mixtures of Th and La nitrate solutions of known content were added to boiling NH_4OH, and the resulting precipitates were transformed to the oxides at 1300°C. The ThO_2 fluorite structure maintained its symmetry up to 52 mole % La_2O_3 inclusion. The asymmetrical method of Straumanis was used to determine the lattice constant, which increased from 5.592 ± 0.001 A for pure ThO_2 to 5.645 ± 0.005 A for the mixed crystal richest in La_2O_3. The densities and lattice constants were calculated for cation- and anion-replacement-type lattices and compared with the observed values. The structure of the mixed crystals is that of a mixed-cation lattice with vacancies in the anion lattice.

6137
CRYSTALLINE STRUCTURE OF LANTHANUM AND PRASEODYMIUM FERRITES. Georges Guiot-Guillain. Compt. rend. 232, 1832-3(1951) May 16. (In French)

X-ray powder diffraction studies of $Fe_2O_3.La_2O_3$ and $Fe_2O_3.Pr_2O_3$ indicate a cubic perovskite structure with lattice constants 3.899 and 3.867 A, respectively.

6138
THE GROWTH OF LARGE SINGLE CRYSTALS OF ALKALI HALIDES FOR SCINTILLATION COUNTING. R. B. Owen. J. Sci. Instruments 28, 221-2(1951) July. (Laboratory and workshop note)

The Kyropoulos method (Z. anorg. u. allgem. Chem. 154, 308(1926)) for growing large clear single crystals of Tl-activated NaI and KI is described. The rate of crystal growth is about 300 g containing 0.25 mole % Tl in 24 hr. The crystals grown measure 3 in. in diameter and 2 in. thick. Larger crystals are reported possible.

DEUTERIUM AND DEUTERIUM COMPOUNDS

6139
VAPOR PRESSURES OF HYDROGEN, DEUTERIUM, AND HYDROGEN DEUTERIDE AND DEW-POINT PRESSURES OF THEIR MIXTURES. Harold J. Hoge and Robert D. Arnold. J. Research Natl. Bur. Standards 47, 63-74(1951) Aug.

The vapor pressures of H_2, HD, and D_2 have been measured from near their triple points to their critical points. The H_2 and D_2 samples were catalyzed to ortho-para equilibrium at 20.4° K. Tables suitable for interpolation have been prepared to represent the results both in centimeter-gram-second and in engineering units. Measurements of dew-point pressures of several binary mixtures have been made at several pressures below atmospheric. Observed pressures were about 3% above those predicted by the law of ideal solutions. (auth)

6140
CRITICAL TEMPERATURES, PRESSURES, AND VOLUMES OF HYDROGEN, DEUTERIUM, AND HYDROGEN DEUTERIDE. Harold J. Hoge and James W. Lassiter. J. Research Nat. Bur. Standards 47, 75-9(1951) Aug.

The critical temperatures, pressures, and volumes of H_2, HD, and D_2 have been determined by measuring short sections of P–V isotherms in the neighborhood of the critical points. The H_2 and D_2 samples were catalyzed to ortho-para equilibrium at 20.4° K and are designated e-H_2 and e-D_2. For e-H the values found are $T_c = 32.9_{94}$° K, $P_c = 12.7_{70}$ atm, and $V_c = 65.5$ cm³ mole^{-1}. For HD the corresponding values are 35.9_{08}° K, 14.6_{45} atm, and 62.8 cm³ mole^{-1}; for e-D_2 the values are 38.2_{62}°K, 16.2_{82} atm, and 60.3 cm³ mole^{-1}. A method of correlating isotherm data for different substances, based on the use of graphs of log P versus log V, is described. (auth)

FLUORINE AND FLUORINE COMPOUNDS

6141
THE RATE OF EVAPORATION OF DROPLETS. V. EVAPORATION CHARACTERISTICS OF SOME BRANCHED-CHAIN HYDROCARBONS AND A STRAIGHT-CHAIN FLUOROCARBON. R. S. Bradley and G. C. S. Waghorn. Proc. Roy. Soc. (London) 206A, 65-72(1951) Mar. 22.

The vapor pressures, latent heats of vaporization, and densities have been determined for $(C_7H_{15})_3CH$ and $(C_{10}H_{21})_3CH$ at 25 to 40°C, and the rate of evaporation of droplets has been studied at a range of air pressures at 25 to 35°C. Diffusion coefficients in air and collision radii have been calculated. The evaporation coefficient is unity. For n-$C_{16}F_{34}$ the vapor pressure and heat of sublimation have been determined at 15 to 30°C, and the values of diffusion coefficients and collision areas have been determined from the evaporation characteristics of solid beads. A comparison has been made of the data for straight- and branched-chain hydrocarbons, and for straight-chain fluoro- and hydrocarbons. (auth)

6142
THERMAL DEHYDROHALOGENATION OF SOME CHLOROFLUOROETHANES. C. W. Huskins, Paul Tarrant, J. F. Bruesch, and J. J. Padbury. Ind. Eng. Chem. 43, 1253-6 (1951) May.

In an effort to develop a more satisfactory method for the preparation of certain haloethylenes, the thermal dehydrohalogenation of some chlorofluoroethanes was studied. The effect of such factors as temperature, contact time, use of diluents, and material of construction of the reaction tube on the vapor-phase thermal dehydrohalogenation of six chlorofluoroethanes has been investigated. Special attention was devoted to the preparation of unsym-dichlorodifluoroethylene, for which conversions up to 78% were obtained at

600°C. Other olefins prepared by thermal dehydrochlorination of the appropriately substituted ethanes included 2-chloro-1,1-difluoroethylene, trichlorofluoroethylene, 1,2-dichloro-1-fluoroethylene, and chlorotrifluoroethylene. A certain temperature is reported at which the maximum conversion to olefin is obtained for each saturated compound at a particular input rate; higher temperatures caused degradation, and at lower temperatures less dehydrohalogenation resulted. Lower conversions were obtained when HCl was removed from ethanes in which the H was bound to a C atom holding F. Hydrogen-containing olefins were produced in lower yields. (auth)

6143
THE HEAT OF DISSOCIATION OF FLUORINE. Russell N. Doescher. J. Chem. Phys. 19, 1070-1(1951) Aug. (Letter to the editor)

Equilibrium pressure measurements for determination of the heat of dissociation of fluorine ($F_2(g) = 2F(g)$) have been completed in the temperature range 759 to 115°K. The problem of reaction between fluorine and the containing vessel was solved by the use of Ni vessel coated stepwise by heating in contact with fluorine at temperatures up to 850°C and the use of a differentially applied manometer containing Fluorolube Standard. The method consisted essentially in a direct comparison of the pressure variation with temperature of a quantity of fluorine with that of a quantity of nitrogen. The value of the mean heat of dissociation in the temperature range of the experiments is 37.7 ± 0.4 kcal/mole, and the heat of dissociation at 1000°K is 38.9 kcal/mole.

6144
THE PREPARATION OF TERMINALLY UNSATURATED PERFLUORO OLEFINS BY THE DECOMPOSITION OF THE SALTS OF PERFLUORO ACIDS. J. Am. Chem. Soc. 73, 4054(1951) Aug. (Communication to the editor)

Report is made of the decarboxylation of salts of the perfluorocarboxylic acids to give the 1-perfluoroolefins in good yield. The procedure is briefly described, and properties of terminally unsaturated perfluoroolefins containing 2, 3, 4, 5, and 9 carbon atoms are tabulated.

6145
MATERIALS FOR FLUORINE CONTROL EQUIPMENT. G. E. Zima and R. N. Doescher. Metal Progress 59, 660-3(1951) May.

Information pertinent to the handling of liquid and gaseous F is presented. Ni and Monel are the only construction materials found by the authors to be satisfactory for F containers. Monel is preferred because of its excellent resistance to hydrogen fluoride. A small-capacity tank for storing liquid F at a pressure of 600 psi is described and diagramed. This tank is composed of three units: An inner container for liquid fluorine, a container for liquid nitrogen, and a high-vacuum insulating shell. The feed lines, valve design, and a rolling-ball type of flowmeter for liquid F are described. A satisfactory Heliarc technique has been developed for Monel welding. In experiments involving the handling of gaseous F, Monel was used for tubing, filter screens, and thermocouple shields, Ni for sodium fluoride purification towers. Teflon valve-stem packing was satisfactory under conditions of low pressure and temperature.

GRAPHITE

6146
Argonne National Lab.
LATTICE VIBRATIONS IN GRAPHITE; by R. Gurney. Apr. 14, 1947. 2p. (AECD-3243; ANL-HDY-561(Rev.))

The frequency spectrum of the graphite lattice is discussed. The usual Debye expressions defining the frequency spectrum are replaced by two-dimensional expressions because at very low temperatures only transverse waves with direction of propagation within the crystal planes and with displacements perpendicular to these planes will be excited. The only other vibrations which have weak restoring forces are longitudinal waves propagated perpendicular to the planes; if the crystallite units are only from 12 to 17 atoms thick, no waves of long wavelength will be associated with these longitudinal waves.

6147
STABILITY OF INTERSTITIAL COMPOUNDS OF GRAPHITE WITH ALKALI METALS. Albert Hérold. Compt. rend. 232, 1484-5(1951) Apr. 16. (In French)

The temperature t_2 at which the vapor pressure of M (K, Rb, or Cs) for C_8M compounds dissociating according to $3C_8M \rightleftharpoons C_{24}M + 2M$ is the same as the vapor pressure of pure M at temperature t_1, has been measured for t_1 from 151 to 344°C. For $t_c = t_2 - t_1$ the following linear functions were found: k, $t_c = 0.22\ t_1 + 45$; Rb, $t_c = 0.49\ t_1 + 55$; and Cs, $t_c = 0.76\ t_1 + 148$. These functions are sensibly proportional to the atomic masses of the metals.

LABORATORIES AND EQUIPMENT

6148
REDESIGN OF A SANITARY ENGINEERING LABORATORY TO PERMIT THE USE OF RADIOISOTOPES. Werner N. Grune and Paul B. Klevin. Nucleonics 9, No. 2, 59-64 (1951) Aug.

The conversion of a particular biochemical laboratory into one equipped to handle biochemical oxidation studies employing radioisotopes safely and successfully at the millicurie level is described. A laboratory equipped specifically for this study cost $1900 for equipment and $1800 for instruments. The procedure used in testing the biochemical oxygen demand (BOD) of sewage containing P^{32} and I^{131} is outlined.

6149
TONGS FOR HANDLING RADIOACTIVE SUBSTANCES. O. Kantorowicz. J. Sci. Instruments 28, 220(1951) July. (Laboratory and workshop note)

Tongs to handle small containers of radioactive isotopes at a distance of some 2 ft are described. The tongs are made of 18-8 stainless steel and are equipped with interchangeable claws.

RADIATION CHEMISTRY

6150
INTERACTION BETWEEN CYSTEINE AND FREE RADICALS FORMED BY X AND γ RAYS IN AQUEOUS OR ALCOHOL SOLUTIONS. Annette Prévot. Compt. rend. 233, 366-8(1951) July 30. (In French)

Various authors have reported notable reductions in mortality of x-irradiated rats on injection of cysteine and other substances previous to irradiation. The possible role played in this phenomenon by free radicals formed by ionizing radiations in solutions is illustrated in experiments described. The polymerizing action of x and γ rays on aqueous and methanol solutions of acrylonitrile and styrene, which is known to be due to reactions involving H and OH radicals, was found to be inhibited by the presence of cysteine. In the case of acrylonitrile this is possibly due to a deviation of H and OH toward cysteine, resulting in a formation of free radicals RS and R, with subsequent recombinations; in the case of styrene, these radicals probably form additional products with styrene, thus preventing the polymerization. The method used consisted in observations on the velocity of polymerization, the latter being measured by concomitant dilatometric changes in the solution.

6151
ON FREE RADICALS PRODUCED BY IONIZING RADIATIONS IN AQUEOUS SOLUTIONS. Joseph Weiss. J. chim. phys. 48, 233-6(1951) May-June.

In a brief account of the recent work in the author's laboratory, a method of detection of OH radicals produced by x rays in aqueous solutions is examined, which consists in the isolation of products of reactions between OH and the organic solute. Reactions studied include the following: $C_6H_6 + OH \rightarrow C_6H_5 + H_2O$, followed by $2C_6H_5 \rightarrow (C_6H_5)_2$ or by $C_6H_5 + OH \rightarrow C_6H_5.OH$; or $C_6H_5.NO_2$ yields $C_6H_4(NO_2)OH$ in the three forms o, p, and m. But apart from the methodological value of such observations, their importance lies in the direct information gathered on the specific reactions involving OH radicals of any origin, whether produced by ionizing radiations or by chemical agents such as those at work in natural biochemical processes. Examples of such reactions are the natural hydroxylation of benzene derivatives, radiochemical hydroxylation of cholesterol, biological oxidation of cholic acid, and oxidative x-ray deaminations of amino acids and of nucleic acids.

6152
HYDROXYL REACTIONS. A. H. W. Aten, Jr. J. chim. phys. 48, 231-2(1951) May-June. (In French)

Several aspects are considered of the oxidizing action of free OH radicals formed as a result either of the ionization of water by radiations, or of purely chemical processes (such as $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + OH^- + OH$). In the presence of two reducing solutes, both are partially oxidized, thus exercising a mutual protective influence against the oxidation; the protection factor is measured by the ratio between corresponding reaction probabilities. It is thought that by comparing protection factors obtained for cases of purely chemical production of hydroxyls with those obtained in radiochemical reactions, it will be possible to ascertain whether the oxidations observed in latter cases are produced exclusively by hydroxyls. Several other aspects of the phenomena could be clarified, e.g., the role of the chain production of OH both in the purely chemical series, and in those oxidations of the radiochemical series which take place in biological systems.

6153
ANALOGY BETWEEN THE CHEMICAL ACTION OF IONIZING RADIATIONS AND ULTRASONICS ON AQUEOUS SOLUTIONS. N. Miller. J. chim. phys. 48, 242-4(1951) May-June.

In a report presented at a meeting in Paris, France, experiments with ultrasonics are described illustrating analogies and differences in the chemical action of that agent and of ionizing radiations. Curves representing the yield in an oxidation of ferrous ions by sound and by γ rays as a function of initial concentration, are similar in that they show a concentration-dependent segment at low concentrations, followed by concentration-independent one; no such features are exhibited by curves representing the effects of α irradiations. In a discussion that followed this report Haissinsky mentioned several instances of oxidizing and reducing actions of ultrasonics that point to a closer analogy with α rays than with x and γ radiations.

6154
ON THE SZILARD-CHALMERS EFFECT PRODUCED BY FAST NEUTRONS. Werner Rieder, Herbert Mueller, and Engelbert Broda. Acta Phys. Aust. 4, 457-60(1951) May. (In German)

The question is discussed whether the yield of the Szilard-Chalmers effect in the irradiation of As and Mn with neutrons is determined by the primary excitation following the capture of neutrons, or is due to secondary chemical reactions. Comparative experiments with fast and slow neutrons have shown that the former interpretation must be the correct one. However, such a conclusion implies the assumption that in the experiments with fast neutrons the activation is actually produced by the fast neutrons emitted by the source; in other words, that the intensity of slow neutrons present is too low to affect the results. This is confirmed by special measurements.

6155
ON INTERCEPTION OF ATOMS IN RADIOCHEMICAL REACTIONS BETWEEN HYDROGEN AND DEUTERIUM. W. Mund, P. Uyskens, and R. Lories. J. chim. phys. 48, 202-5(1951) Mar.-Apr. (In French)

The law of equilibrium adjustments produced by α rays in a H_2/D_2 mixture is deduced from probability considerations on exchange reactions between H_2, D_2, HD, H, and D. Modifications of that law, brought about by the presence of molecules of an inhibiting substance intercepting H and D atoms, are considered; this is done with the aid of a hypothesis, borne out by special experiments, that the interception, being a manifestation of Van der Waals forces, is independent of the nature of the inhibitor.

RADIATION EFFECTS

6156
THEORY OF RADIATION CHEMISTRY. I. SOME EFFECTS OF VARIATION IN IONIZATION DENSITY. John L. Magee. J. Am. Chem. Soc. 73, 3270-75(1951) July.

The ionization density in a homogeneous medium exposed to steady irradiation is a function of space and time. The space-time ionization density pattern depends on both the ionization density of the particles used in the irradiation and the number of particles incident per unit time and area (i.e., the rate of irradiation). In this paper a simple model is presented which describes the life of a particle track in the steady-state condition and thus also gives a description of the variations in ionization density. The author believes that this model contains the essentials of the actual physical situation, and it has the particular advantage that mathematical treatment can be carried out rigorously. In the model, account is taken of the background ionization density which is present when a track is formed; this background ionization density can be higher or lower than that of the track itself depending upon the diffusion rate of the ions and radicals formed, their recombination rate constants, and the rate of irradiation, Yields in radiation chemistry depend upon whether the background is high or low; this situation is discussed in terms of the model with application to some problems of radiation chemistry. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

6157
California Univ., Berkeley
COMPLEX IONS OF LANTHANUM IN AQUEOUS SOLUTIONS. (dissertation) Kenneth Lawrence Mattern. [nd] 100p. figs. (UCRL-1407)

The complexing of La by various anions and weak acids was investigated by observing the light absorption of the complex formed with thenoyltrifluoroacetone (TTA). The aqueous spectra of TTA and its enolate ion were checked, and the acid dissociation constant for TTA was redetermined. The experimental value, $K^0_{298} = 2.96 \times 10^{-7}$, was found to disagree with the constant reported previously: $K^0_{298} = 6.7 \times 10^{-7}$. The molar extinction coefficient for the La-TTA complex ion was measured and used to determine the concentration of the complex in the various solutions. The complexing constant was studied as a function of temperature at an ionic strength of unity. Acetate ion was found to complex La ion partially under the buffer conditions used, and the equilibrium constant for the reaction was

investigated as a function of temperature. Values of the La complexing constants for Cl^-, NO_3^-, SO_4^{--}, ClO_3^-, acetate, succinate, tartrate, phthalate, lactate, and citrate were determined. Some of these were studied as a function of temperature, and values of the heat and entropy were calculated for the reactions. Li^+ ion was found to form a weak complex with TTA; stability of the complex was measured as a function of temperature and ionic strength.

6158
THE OXIDES OF CERIUM. I. G. Brauer and U. Holtschmidt. Z. anorg. u. allgem. Chem. 265, 105-16(1951) June. (In German)

Commercially pure CeO_2 exhibits measurable reduction in circulating H_2 at 500°C. Admixture of as little as 0.005% Pr_2O_3 substantially increases the rate of reduction. Observations on the reducibility in H_2 of various Ce oxide preparations at 1000°C over a period sufficient to cause complete transformation into Ce_2O_3 are reported.

6159
NOTE ON REDUCTION OF CERIUM DIOXIDE, ESPECIALLY IN THE RANGE OF 250 to 350°C. G. Rienacker and M. Birchenstaedt. Z. anorg. u. allgem. Chem. 265, 99-104 (1951) June. (In German)

The partial reduction of CeO_2 at 250 to 350°C has been studied in static and circulating H_2. A progressive color change from yellow-white to gray-blue occurs up to about 12% reduction. Both this product and the dark-blue "Ce_4O_7" mentioned in the literature (Myer, Z. anorg. u. allgem. Chem. 37, 378(1903)) and obtained at 1000°C show only the x-ray-diffraction lines of the CeO_2 structure. It is concluded that Ce_4O_7 is not a definite compound and that reduction at low temperature removes O atoms from the CeO_2 lattice.

6160
LANTHANON COMPLEXES WITH ETHYLENEDIAMINE-TETRA-ACETIC ACID. Part I. R. C. Vickery. J. Chem. Soc., 1817-21(1951) July.

Marsh's work (J. Chem. Soc., 1819(1950)) on (ethylenediamine)tetraacetic acid (EDTA) complexes of the heavy lanthanons has been supplemented by investigations on the use of this reagent in separating the lighter earths. Excellent separation of La and good concentration of Sm have been obtained, together with a certain degree of differentiation between Nd and Pr. Various modifications have been examined and some crystalline complexes prepared and analyzed. Further evidence has been obtained of two-stage coordination (Vickery, J. Chem. Soc., 2058(1950)), and some preliminary titration studies have been made. (auth)

6161
OVERVOLTAGE IN THE CEROUS-CERIC OXIDATION-REDUCTION SYSTEM. Eugène Lewartowicz. Compt. rend. 232, 1756-8(1951) May 7. (In French)

The transfer coefficients and activation energies of the $Ce^{+3} \rightleftarrows Ce^{+4} + e$ equilibrium have been determined by application of the overvoltage theory of Audubert (J. phys. radium 3, 81-9(1942)). The advantages of using a reversible oxidation-reduction reference electrode are stressed.

6162
THE COMPLEXONS. XIX. CONSTANTS OF COMPLEX FORMATION BETWEEN HEAVY METALS AND NITRILO-TRIACETIC ACID. G. Schwarzenbach and Elsi Freitag. Helv. Chim. Acta 34, 1492-502(1951) Aug. 1. (In German)

Equilibrium constants of associations between a metal cation and the nitriloacetate ion $N(CH_2COO^-)_3$ are determined for 20°C using 0.1N KCl as a solvent. La is among the metals used.

6163
THE COMPLEXONS. XX. STABILITY CONSTANTS OF COMPLEXES BETWEEN HEAVY METALS AND ETHYLENEDIAMINETETRAACETIC ACID. G. Schwarzenbach and Elsi Freitag. Helv. Chim. Acta 34, 1503-8(1951) Aug. 1. (In German)

Equilibrium constants of associations between a metal cation and (ethylenediamine) tetraacetate ion $(CH_2.COO^-)_2$: $NCH_2CH_2N:(CH_2COO^-)_2$ are determined for 20°C using 0.1N KCl as a solvent. La is among the metals used.

SEPARATION PROCEDURES

6164
Naval Research Lab., Univ. of Wisconsin
THE EFFECT OF ULTRASONIC RADIATION ON THE ELECTROLYTIC SEPARATION OF DEUTERIUM; by Donald F. Mason, Royce E. Biddick, and Charles A. Boyd. July 31, 1951. 14p. (NP-3348)

The application of ultrasonic radiation to the polished platinum cathode of an electrolysis cell is shown to increase the coefficient for the electrolytic separation of deuterium. The radiation also decreases the temperature dependence of the separation coefficient. This is thought to be due to the rapid removal of the discharged gases by the ultrasonic radiation, preventing the surface-catalyzed exchange reaction between the discharged gases and the electrolyte. (auth)

6165
Ames Lab.
DEVELOPMENT OF A PROCESS FOR THE PRODUCTION OF A HIGH HAFNIUM CONCENTRATE; by A. Jacobs, R. D. Masteller, and G. H. Beyer. June 1, 1951. 33p. (ISC-140)

A method for producing a high-Hf concentrate from a recently developed adsorption-separation process for the production of pure Zr (Hansen et al., J. Am. Chem. Soc. 72, 5043-5(1950)) would make this latter process cheaper by the value of the by-product and would provide a feed material for the production of pure Hf. The results of experimental runs in various-sized columns in which $HfCl_4$ and $ZrCl_4$ were adsorbed from CH_3OH solution on activated silica gel, which was then stripped by a CH_3OH-HCl solution followed by H_2SO_4 are reported. An estimated 70% of the initial Hf in a feed material containing 2 wt. % HfO_2 can be recovered as 90 wt. % HfO_2 in two process cycles.

6166
SOME RESULTS OF THE APPLICATIONS OF ION-EXCHANGE CHROMATOGRAPHY TO NUCLEIC ACID CHEMISTRY. Waldo E. Cohn. J. Cellular Comp. Physiol. 38, Suppl. 1, 21-40(1951) July.

The application of ion exchange to nucleic acid chemistry has resulted in quantitative separation techniques for the nucleotides, nucleosides, and bases derived from nucleic acids. These techniques have, in turn, resulted in the discovery of isomers of all 4 ribose nucleotides and of desoxy-5-methyl-cytidylic acid. A method for the quantitative separation of adenosine di- and triphosphates has also been devised. It is proposed to apply the technique to the isolation of pure polynucleotides from enzymatic or chemical digests of nucleic acids. (auth)

6167
SEPARATION OF CHROMIUM FROM VANADIUM. Robert K. Brookshier and Harry Freund. Anal. Chem. 23, 1110-13 (1951) Aug.

Research by the U. S. Bureau of Mines on the recovery of vanadium from low grade ferrophosphorus required the determination of small amounts of chromium in vanadic oxide products. The titrimetric method is inaccurate, and Foster's perchromic acid extraction procedure gave erratic results. Study of the variables influencing the extraction led to the following optimum conditions: pH at equilibrium 1.7 ± 0.2, concentration of hydrogen peroxide 0.02 mole per liter, temperature 20°C or less, and number of extractions 3. Adherence to these conditions, with final

estimation of chromium with s-diphenylcarbazide, yields a more sensitive and reliable method than any heretofore described.

6168
SEPARATION OF ALKALI IONS USING ION EXCHANGERS AND A COMPLEXON. W. Buser. Helv. Chim. Acta 34, 1635-41(1951) Aug. 1.

Using Na^{24} and K^{42}, it was found that the separation of Li, Na, and K with the aid of ion exchangers (amberlite) can be considerably accelerated when complexes of Na^+ and Li^+ with uramildiacetic acid are employed (uramil is 5-amino-barbituric acid). The affinity toward the exchanger decreases in the order K^+, NH_4^+, Na^+, $(CH_3)_2NH_2^+$, Li^+, $(CH_3)_4N^+$. (auth)

6169
ELECTROPHORESIS OF PROTEINS ON FILTER PAPER. Henry G. Kunkel and Arne Tiselius. J. Gen. Physiol. 35, 89-118(1951) Sept.

A simplified procedure for filter paper electrophoresis is described in which disturbing factors such as evaporation, heating, buffer concentration gradients, and pH changes in the electrode vessels were reduced to a minimum. Artifical mixtures of highly purified proteins could be separated and the components isolated. The application of the method to a variety of studies on serum proteins is demonstrated. Protein concentration in paper segments was determined by two different methods of protein estimation. Curves were obtained showing the same five major peaks for normal serum as found by the classical methods of free electrophoresis. Comparisons were made of the areas of the various components under the curves obtained with the different methods. Two dimensional electrophoresis was applied to serum and serum components. It proved of value in demonstrating the heterogeneity of fractions such as the γ-globulin of serum. (auth)

6170
INORGANIC CHROMATOGRAPHY ON CELLULOSE. Part V. THE USE OF COLUMNS OF CELLULOSE IN COMBINATION WITH ORGANIC SOLVENT EXTRACTION FOR THE SEPARATION OF URANIUM FROM OTHER METALS. F. H. Burstall and R. A. Wells. Analyst 76, 396(1951) July. (See also NSA 4-3685)

A new method is described for the separation of uranium from other metals. It is based on the extraction of uranyl nitrate with ether containing 5% v/v of nitric acid in the presence of cellulose. The method has been applied to the determination of uranium in minerals and ores with results that compare favorably in simplicity, rapidity, and accuracy with other methods. The behavior of a number of other anions and cations in the process has been investigated and methods have been devised for overcoming difficulties caused by the presence of some metals and acid materials on the extraction process. (auth)

6171
A MACHINE FOR DIFFUSION SEPARATION OF GASES. H. Korsching. Z. Naturforsch. 6a, 213-17(1951) Apr. (In German)

A new apparatus for the separation of gas mixtures is described, based on a combination of two processes, viz., the diffusion into an incoming auxiliary gas, and the mechanical transport in a direction perpendicular to that of the flow of the auxiliary gas. Measurements made on a number of gas mixtures are reported. (auth)

SORPTION PHENOMENA

6172
RATES OF GASEOUS ABSORPTION INVOLVING REVERSIBLE CHEMICAL REACTION WITHIN THE LIQUID FILM. S. L. Sastry and James Coull. J. Sci. Ind. Research (India) 10A, 284-91(1951) July.

Equations have been derived for the rate of material transfer through a liquid film when such transfer is accompanied by a reversible chemical reaction between the material being transferred and a component in the liquid film. Assuming that the reaction is of the type $A + B \rightleftharpoons C$, two independent cases have been worked out for very slow rates of diffusion of B, and of C, within the liquid film. These rates of transfer lead to modified expressions for the height of the liquid film transfer unit which involve the equilibrium constant. When there is no reaction in the liquid film, these expressions reduce themselves to the well-known expression for the height of a liquid film transfer unit. (auth)

6173
ON THE ADSORPTION OF RADON BY ACTIVATED CHARCOAL AND SILICAGEL. O. Gübeli and K. Stammbach. Helv. Chim. Acta 34, 1257-63(1951) Aug. 1. (In German)

The adsorption of the mixture of radium emanation with air on silicagel and linden charcoal is investigated, the air acting as a carrier. Charcoal in considerably more active than silicagel at the same temperature. From the data obtained, the isosteric adsorption heats are calculated. (auth)

SYNTHESES

6174
BIOSYNTHESIS OF CITRIC ACID. S. F. Carson, E. H. Mosbach, and E. F. Phares. J. Bact. 62, 235-8(1951) Aug.

Labeled citric acid was synthesized by Aspergillus niger from sucrose in the presence of sodium acetate-2-C^{14} and $C^{13}O_2$. The labeled citric acid was degraded by a new method which allowed a separate isotope determination of each of the six carbon atoms. The finding of wide divergence in labeling between the primary carboxyls confirmed the Ogston concept in the case of a microbial system. The experimental evidence indicated extensive C_4- or C_6-acid cycling in an organism which has a carbon metabolism predominantly shifted toward the bulk production and excretion of citric acid. (auth)

6175
SYNTHESES WITH ISOTOPIC TRACER ELEMENTS. PART III. THE PREPARATION OF ETHYLENE OXIDE AND ETHANOL LABELLED WITH CARBON ISOTOPES. J. D. Cox and R. J. Warne. J. Chem. Soc., 1893-6(1951) July.

A method is described for the synthesis from $BaCO_3$ by way of actylene and ethylene chlorohydrin, on the 2–5 millimole scale, of C^{14}-labeled ethylene oxide; reduction of the product with $LiAlH_4$ leads to $\alpha\beta$-labeled ethanol. (auth)

6176
SYNTHESES WITH ISOTOPIC TRACER ELEMENTS. PART IV. THE PREPARATION OF METHYLAMINE AND DIAZOMETHANE LABELLED WITH CARBON ISOTOPES. J. D. Cox and R. J. Warne. J. Chem. Soc., 1896-7(1951) July.

A technique for preparing C^{14}-labeled methylamine from labeled methyl iodide, utilizing the Gabriel reaction, has been developed; the amine has been converted into carbon-labeled diazomethane with an over-all isotopic yield (based on labeled $BaCO_3$ of 55%. (auth)

6177
A CONVENIENT SYNTHESIS OF CARBON-LABELLED BENZENE. Nature 168, 73-4(1951) July 14. (Letter to the editor)

A preliminary report of a convenient synthesis of C-labeled benzene is given. The procedure consisted of in the aluminium-halide catalyzed rearrangement of alkyl cyclopentanes to cyclohexanes followed by dehydrogenation

of the cyclohexane. Benzene was isolated by formation of the clathrate compound with ammoniacal Ni cyanide solution. An over-all yield of benzene from CO_2 of approximately 45% has been obtained.

6178
METHOD OF PREPARATION OF AROMATIC BROMINE DERIVATIVES LABELED WITH Br^{82} (Laboratory note). Fernand Kieffer and Paul Rumpf. Bull. soc. chim. France (5) 18, 584-5(1951) July-Aug. (In French)

Br^{82} may be introduced into the naphthalene nucleus by an exchange reaction between $LiBr^{82}$ and α- or β-bromonaphthalene in alcohol at 260°C. Washing the ether extract of the labeled product with aqueous $AgNO_3$ and water is the only purification necessary.

6179
PREPARATION OF ACETIC-2-C^{14} ACID. Daniel N. Hess. J. Am. Chem. Soc. 73, 4038(1951) Aug. (Notes)

A method has been developed for the preparation of high specific activity acetic-2-C^{14} acid from methanol-C^{14}. The method involves the intermediate formation of methyl hydrogen sulfate and acetonitrile. Yields averaging 87% have been obtained on a 10-millimole scale.

6180
MICROSYNTHESIS USING C^{13} OR C^{14}. I. MICRO AND SEMI-MICRO PREPARATIONS OF ORGANIC ACIDS FROM BARIUM CARBONATE. C. Baret and L. Pichat. Bull. soc. chim. France (5) 18, 580-3(1951) July-Aug. (In French)

Microtechniques used to introduce isotopic carbon into the carboxyl group of acetic, trimethyl acetic, benzoic, and cyclohexyl carboxylic acids, using 0.0001 to 0.015 mole of $BaCO_3$, are described. Effects of temperature, concentration, and proportion of Grignard reagents on the yields are considered.

TRACER APPLICATIONS

6181
Wisconsin Univ.
SOME APPLICATIONS OF RADIOACTIVE TRACERS TO PHYSICAL CHEMICAL PROBLEMS; by John E. Willard. [nd] 27p. (AECU-1612)

The effectiveness and versatility of tracers are illustrated in a general discussion of some specific applications of Br^{80}, Br^{82}, Cl^{36}, Cl^{38}, I^{128}, Na^{22}, Na^{24}, and S^{35}. Tracer studies on sorption of ions by glass, solubility determinations, intraionic and interionic exchange, intermolecular exchange reactions, Friedel-Crafts reactions, and reactions of atoms having high kinetic energy or high positive charge are summarized.

6182
A REVIEW OF THE USES OF ISOTOPIC CARBON IN ORGANIC CHEMICAL RESEARCH. Gus A. Ropp and O. Kenton Neville. Nucleonics 9, No. 2, 22-37(1951) Aug.

The use to which isotopic carbon has been put in the following types of investigation is reviewed: ring enlargement by Tiffeneau rearrangement, rearrangement of α-diketones, Favorski reaction, rearrangements of carbon atoms in t-butyl and t-amyl derivatives, Wagner rearrangements of aromatic hydrocarbons, reactions involving loss or gain of carbon of carbon fragments, structure proof, isotope effect, exchange reactions, and dilution method analysis.

6183
DETERMINATION OF CARBONYL GROUPS BY REACTION WITH RADIOACTIVE CYANIDE, AND A SIMPLE MEANS FOR ESTIMATION OF MOLECULAR WEIGHT IN POLYSACCHARIDES. Horace S. Isbell. Science 113, 532-3(1951) May 4. (Comments and communications)

It has been found that the reducing end groups of polysaccharides can be combined with C^{14}-labeled sodium cyanide to give a cyanhydrin that on saponification yields a radioactive carbohydrate containing one carbon more than the parent polysaccharide. The combining proportion of the radioactive cyanide can be determined accurately. This is a measure of the average molecular weight of the reacting polysaccharide. The procedure provides not only a new tool for structural studies, but also a means for labeling carbohydrate material for biological and other investigations.

TRANSURANIC ELEMENTS AND COMPOUNDS

6184
MAGNETOCHEMISTRY OF THE HEAVIEST ELEMENTS. PART IV. PLUTONIUM TRIFLUORIDE AND TRICHLORIDE. J. K. Dawson, C. J. Mandleberg, and D. Davies. J. Chem. Soc., 2047-50(1951) Aug.

The magnetic susceptibilities of PuF_3 and $PuCl_3$ have been measured over the temperature range 90 to 600°K. There is a minimum between 500 and 550°K in the susceptibility–temperature curve of the tervalent plutonium ion, and the close resemblance of this behavior to that of the tervalent samarium ion is taken as good qualitative evidence for a $5f^5$ electronic configuration for the plutonium ion. The application of Van Vleck's method for calculating the theoretical susceptibility yields 58 as the most probable value of the spin-doublet screening constant. (auth)

URANIUM AND URANIUM COMPOUNDS

6185
THE OSMOTIC AND ACTIVITY COEFFICIENTS OF URANYL NITRATE, CHLORIDE, AND PERCHLORATE AT 25°. R. A. Robinson and C. K. Lim. J. Chem. Soc. 1840-3(1951) July.

Isopiestic vapor-pressure measurements have been made on solutions of uranyl nitrate, chloride, and perchlorate at 25°C from 0.1 to 5.5M, 3.2M, and 5.5M, respectively, and the osmotic and activity coefficients of these salts calculated. Some support has been found for the hypothesis that addition of UO_3 leads to formation of the $U_3O_8^{++}$ ion rather than the $UO_2(OH)^+$ ion. (auth)

6186
THE CHEMISTRY OF URANIUM. PART I. THE ELEMENT, ITS BINARY AND RELATED COMPOUNDS. (National Nuclear Energy Series; Div. VIII, Vol. 5). Joseph J. Katz and Eugene Rabinowitch. New York, McGraw-Hill Book Company, Inc., 1951. 609p.

A comprehensive detailed summary of the "dry chemistry" of U is presented. The occurrence of U in nature, its extraction from ores, and the physical and chemical properties of the metal are treated thoroughly. Binary compounds of U with H, O, N, and the halogens, among others, receive extensive discussion, including methods of preparation and physical properties such as crystal structure, thermochemistry, and volatility. This volume is to be followed by a companion book dealing with the properties of ionic U in aqueous solution. A more extensive review by I. Perlman appeared in Nucleonics 9, No. 4, 69-70(1951) Oct.

ENGINEERING

6187
North American Aviation, Inc.
THE ANALYSIS AND DESIGN OF HYDRODYNAMIC GAS BEARINGS; by R. R. Weber. Sept. 6, 1949. 27p. (NAA-AL-699)

The object of this report is to present a practical engineering approach to the design and analysis of gas bearings which are used for relatively stationary applications, such as gyroscope and accelerometer supports and wind-tunnel balance bearings. The principles defined may also be used for designing high-speed rotating bearings; however, in this case additional supporting pressure may be generated by the relative velocity of the rotating parts. The fundamental theory of operation of single-disk pad and journal types of gas bearing supports is presented from the standpoint of gas consumption and load-carrying ability. An attempt has been made to illustrate the optimum or desirable values for the different bearing parameters. Two typical examples, a spherical bearing with four pads and a journal bearing, have been worked out to illustrate the design techniques.

HEAT TRANSFER AND FLUID FLOW

6188
Metallurgical Lab., Univ. of Chicago
EFFECT OF IMPERFECT MIXING IN STREAMS; by William Karush. Apr. 6, 1945. Decl. Sept. 24, 1951. 11p. (AECD-3245; CP-2900)

A theoretical method of calculating the temperature field in a turbulent stream flowing through a narrow rectangular channel is proposed. The theory is based on the assumption that heat flow within the stream takes place by two mechanisms: ordinary convection due to the time mean motion of the liquid and eddy diffusion (sometimes called kinematic eddy viscosity).

6189
Metallurgical Lab., Univ. of Chicago
SOME PROBLEMS IN EDDY DIFFUSION; by William Karush. Aug. 15, 1945. Decl. Sept. 24, 1951. 19p. (AECD-3244)

Several problems involving the diffusion of heat by eddy motion in turbulent streams are considered. Diffusion normal to the walls is estimated from Nikuradse's curves and applied to the calculation of the heat transfer coefficient for fluids of high thermal conductivity, such as liquid metals. Sidewise diffusion parallel to the walls of a flat stream is treated; an application to the rib effect is made. (auth)

6190
A PROBLEM IN RADIAL HEAT FLOW. H. Goldenberg. Brit. J. Applied Phys. 2, 233-7(1951) Aug.

The heat equation is solved for the case of constant heat/unit volume/unit time, generated in a spherical region of a homogeneous infinite medium. Curves are drawn showing the transient temperature: (1) at the center of the spherical region; (2) at the surface of the spherical region; and (3) at a distance from the center of twice the radius. The transient temperature at any point of the medium may readily be calculated from the expressions derived, as, apart from material constants, these expressions involve only tabulated functions. (auth)

6191
METHOD OF POTENTIALS APPLIED TO A THEORY OF THE NON-STATIONARY MOVEMENT OF A THIN LAMELLA. Serge Vladimirsky. Compt. rend. 233, 352-4(1951) July 30, (In French)

Using algebraic-function integrals, an expression is derived for the complex potential corresponding to the case of nonstationary motion of an infinitely thin lamella. The result is applied to the calculation of the turbulence intensity in a wake. (auth)

6192
SECONDARY CIRCULATION IN FLUID FLOW. W. R. Hawthorne. Proc Roy. Soc. (London) 206A, 374-87(1951) May 7.

Secondary circulation appears after fluid with a nonuniform velocity distribution passes around a bend. It alters the character of the flow and is a source of loss. A general expression is developed for its change along a streamline in a perfect, incompressible fluid. The flow in bent circular pipes is analyzed and the theory is compared with experiments on bent pipes and rectangular ducts. In bends the secondary flow is not spiral but oscillatory, the direction of the circulation changing periodically. The theory shows that secondary circulation remains unchanged if streamlines are geodesics on surfaces of constant total pressure. (auth)

6193
STREAM FUNCTIONS FOR THREE-DIMENSIONAL FLOWS. J. H. Giese. J. Math. Phys. 30, No. 1, 31-5(1951) Apr.

It is well known that plane or axisymmetric steady, nonviscous, adiabatic flows with vorticity can be described completely by means of a single-stream function. The fact that steady three-dimensional flows with vorticity can be described by means of two-stream functions has received less attention, perhaps because the formidable appearance of the system of partial differential equations for these functions makes their usefulness doubtful. In this note it is shown that these general stream functions have properties analogous to those of the familiar special cases, and that they can be used to verify a variational principle for three-dimensional flows.

6194
VELOCITY DISTRIBUTION IN THE VICINITY OF A WALL MOVING PARALLEL TO A FLUID STREAM. Charles Bory. Compt. rend. 233, 350-2(1951) July 30. (In French)

As a part of a study of convective heat exchanges in arrangements comprising mobile walls, a theoretical examination of the following problem is made. A half-plane presents its edge to a fluid moving uniformly in a direction parallel to the half-plane. Unlike the classical setup, the edge and the adjoining part of the half-plane, up to a given distance from the edge, are fixed, only the remaining part of the half-plane being mobile; its velocity is that of the fluid. What is the disturbing action of the edge on the fluid's velocity? This question is answered by data showing the rate of the uniformization of velocity as a function of the distance from the edge.

PUMPS

6195
Radiation Lab., Univ. of Calif.
CENTRIFUGAL SODIUM PUMP FOR THE PURIFICATION OF INERT ATMOSPHERES; by LeRoy A. Bromley, Russell K. Edwards, and Raleigh L. McKisson. Aug. 30, 1951. (UCRL-1463)

A centrifugal liquid-Na pump and contacting tray of new design are described and recommended for the removal of oxidizing gases from inert-atmosphere working chambers. The drive shift from a 1/50-HP Bodine motor passes down through silicone-lubricated bearings to the impeller. Just below the lower bearing, a downward-directing helical

pump element is affixed to the shaft to direct the liquid metal away from the bearing. The shaft extends below the impeller, passes through an opening in the intake screen, and drives the wiper-disintegrator blade. The Na is pumped up the riser tube to the top of the contacting tray, where it discharges onto the downward-sloping tray through a number of orifices. After running down the tray where it contacts the circulating atmosphere, the sodium drops into the reservoir. This scavenging unit is free from bearing failure, noise, and vibration.

RADIOGRAPHY

6196

NUCLEAR REACTION RADIOGRAPHY. Mats Hillert. Nature 168, 39-49(1951) July 7.

The "nuclear reaction radiography" suggested makes use of the ability of the nonradioactive elements in question to react differently to an external particle radiation. New radiations are produced in the process and are registered on the photographic film. The film must be insensitive to the primary radiation, practically limiting the latter to neutrons. A photomicrograph of an eutectic of Fe and Fe_2B is shown to illustrate the feasibility of the method.

6197

GAMMA RADIOGRAPHY IN THE UNITED KINGDOM. W. S. Eastwood. Nucleonics 9, No. 1, 50-9(1951) July.

A discussion is given of the radioisotopes produced at Harwell for nondestructive testing. Co^{60}, Eu^{154}, Ta^{182}, Sb^{124}, Sc^{46}, Ir^{192}, Se^{75}, Hf^{181}, and Ce^{144}-Pr^{144} were tested, but only Co^{60}, Ta^{182}, and Ir^{192} were useful enough to warrant production. Standard sizes of sources have been made in the form of cylinders having diameter equal to length of dimensions 6 mm, 4 mm, 2 mm, 1 mm, and in special cases 0.5 mm. Choice of source and radiographic technique is considered. For the recommended range of steel thickness, Co^{60} and Ta^{182} can be expected to give 2 to 4% sensitivity and in some cases better. For Ir^{192}, sensitivities of 1 to 2% can be achieved even in steel sections only 3/8 in. thick.

MINERALOGY, METALLURGY, AND CERAMICS

6198

Alabama Univ.

ENAMELS FOR METALS; by J. H. Handwerk and T. N. McVay. 1951. 96p. (ORO-47)

The characteristics of special enamel compositions containing large amounts of oxides known to have the property of absorbing neutrons and gamma radiation were studied. Several base enamels were first developed, and a standard procedure set up. Enamels containing barium oxide, lead oxide, lithium oxide, cadmium oxide, and boric oxide were prepared. Composition and methods of preparation of each enamel are included. A series of laminated plates were prepared using iron sheets bonded together with an enamel. Thermal tests on these sheets proved unsatisfactory due to a difference in the thermal expansion coefficient of the enamel used in bonding and that of the metal. Preliminary studies on the protection of metals at high temperatures showed that enamels apparently are an aid in preventing iron plates from oxidizing at high temperatures.

CERAMICS AND REFRACTORIES

6199

THE STUDY OF SINTERING PHENOMENA BY MEANS OF CONTINUOUS CONTRACTION MEASUREMENTS. S. Tacvorian and M. Lévêcque. Engrs. Digest 12, 155-8(1951) May.

Continuous measurement of the linear contraction of a test bar during sintering in a high-frequency furnace permits observation of the physicochemical changes in the material as sintering progresses. A suitable instrument is described by which contractions of solid materials undergoing transformation changes can be detected if the linear variations produced are greater than 0.1%. In one continuous experiment, the instrument supplies information about sintering temperatures, about the progress of contraction or expansion, and about over-all contraction, thus elucidating theoretical and practical aspects of sintering phenomena. Tests on alumina, with additions of MgF_2, for instance, prove that a fine-grained sintered product is obtained not by slow sintering at low temperatures but, paradoxically, only by preventing the tendency to sintering at low temperatures. Examples of observations on ceramic materials are given. 6 graphs.

6200

FABRICATION OF FRITTED PURE CALCIUM FLUORIDE OBJECTS. Charles Eichner and Roger Caillat. Bull. soc. chim. France (5) 18, 139(1951) Jan.-Feb. (In French)

CaF_2 melts at about 1360°C and is not usually considered a refractory. However, it is not attacked up to 1200°C by F compounds or by molten U metal. Crucibles and molds of several liters capacity may be formed by molding powdered natural CaF_2 with methylcellulose or starch, drying, and fritting at 800 to 900°C. Pieces of the fritted material may be cemented together with a CaF_2 paste.

6201

CERAMICS FROM ZIRCON AND LANTHANUM OXIDE. Félix Trombe and Marc Foëx. Compt. rend. 233, 254-6 (1951) July 16. (In French)

The high electric conductivity of certain ceramic mixtures of zircon with oxides of rare earths was formerly utilized by Nernst in the construction of electric lamps. The peculiar properties of such mixtures are studied here. Zircon and La_2O_3, fused in various proportions in a solar furnace, show, when examined with x rays or in a polarizing microscope, various structures (solid solutions and eutectics) changing with the proportion of the components. These findings are confirmed by measurements of the electric conductivity which passes through a maximum when the proportion is 10 mole % La_2O_3 for 90 mole % $ZrSiO_4$. Only ceramics containing 3 to 35 mole % La_2O_3 are stable in air and are resistant to thermal shocks.

METALS AND METALLURGY

6202

Utah Univ.

PHYSICAL CHEMISTRY OF GALLIUM-INDIUM ALLOYS; STATUS REPORT APRIL 1, 1948–JUNE 30, 1948. J. Hugh Hamilton, John R. Lewis, and J. P. Denny. [nd] 8p. (NP-3340)

6203

Utah Univ.

PHYSICAL CHEMISTRY OF GALLIUM-INDIUM ALLOYS; STATUS REPORT OCTOBER 1–DECEMBER 31, 1948.

J. Hugh Hamilton, John R. Lewis, and J. P. Denny. [nd] 6p. (NP-3343)

6204

Utah Univ.

PHYSICAL CHEMISTRY OF GALLIUM-INDIUM ALLOYS; STATUS REPORT JULY 1–SEPTEMBER 30, 1948. J. Hugh Hamilton, John R. Lewis, and J. P. Denny. [nd] 70p. (NP-3339)

6205

Metals Research Lab., Carnegie Inst. of Tech.

ELECTROCHEMICAL STUDIES OF NON-AQUEOUS MELTS; QUARTERLY PROGRESS REPORT; PERIOD ENDING JUNE 1, 1951; by Robert F. Mehl and Gerhard Derge. 12p. [nd] (NYO-826)

The special fused-salt polarographic cell described in the Mar. 1, 1951, quarterly progress report (NYO-825) was found to be unsatisfactory because a continuous thread of molten Sn could not be obtained in the fine capillary; a stationary Pt electrode is being investigated. An a-c Kelvin-bridge circuit and a matte-conductivity cell are illustrated. Preliminary measurements indicate that a 40 wt. % Cu_2S liquid matte has an electrical conductivity of about 200 ohm^{-1}/cm at 1000°C. The conductivity and electrolysis circuits of the differential pressure cell used in studying electrolysis of iron-silicate slags are sketched, and some preliminary data are given. The decomposition potential of 5% Cu_2Cl_2 in a molten LiCl-KCl eutectic was found to be in the region of 900 mv when Pt is used for both electrodes. V metal has been plated from a 5 wt. % solution of VCl_2 in the molten LiCl-KCl eutectic. Decomposition potential curves are presented for 1M VCl_2 in LiCl-KCl and for 5% Cu_2Cl_2 in LiCl-KCl eutectic. A preliminary study by the Sieverts "hot volume" method indicates that the S gases resulting from the equilibrium of SO_2 with hot graphite go into the slag in true solution without displacement of O_2 by metathesis.

6206

Carbide and Carbon Chemicals Co., Y-12

ALKALI METALS AREA SAFETY GUIDE; by Preston L. Hill. Aug. 13, 1951. 32p. (Y-811)

Outlines of principles and practices in the safe handling of molten Na, K, Li, and NaK metals are presented. Indoctrination of employees, general Y-12 plant procedure, personal safety gear and protective equipment, fire prevention and fire fighting, first aid, safety in servicing tanks, lines, or valves containing alkali metals, disposal of waste, equipment cleaning, and correct use of tools and chemicals are outlined.

6207

Sylvania Electric Products, Inc.

THE HOT-WIRE PROCESS FOR ZIRCONIUM; by Robert B. Holden and Bernard Kopelman. Issued June 28, 1951. 28p. (SEP-58(X)(rev.))

In order to better understand the hot-wire process for Zr, a study has been made of the thermal decomposition of Zr tetraiodide molecules which are isolated from the effects of interaction with other tetraiodide molecules and with the reaction products. It was found that the probability that a given Zr tetraiodide molecule will decompose upon striking once upon a hot surface in vacuo is very high, approaching unity at 1400°C. This work was supplemented and extended by a second series of investigations, which were based upon pressure measurements made inside of an operating cracking bottle. From these two experimental approaches considerable information was gained about the hot-wire process, including a knowledge that the rate-determining step is that of gaseous transport, and that the initial synthesis of Zr tetraiodide in the cracking bottle is catalyzed, apparently photochemically, by the lighting from the filament. (auth)

6208

Oak Ridge National Lab.

HEAT CAPACITY OF MOLYBDENUM; by T. A. Redfield and J. H. Hill. Issued Sept. 24, 1951. 9p. (ORNL-1087)

Using a Bunsen ice calorimeter (ORNL-1040) measurements were made of the changes in enthalpy of molybdenum in the temperature range 200 to 1100°C. The empirical expression $H_t - H_0 = 0.0675t - 0.37$, where t is the temperature in °C, was determined by least squares. The heat capacity was then derived from the enthalpy measurements and found to be 0.0675 cal/g/°C over the temperature range investigated. The accuracy of results was determined to be within 5%.

6209

Massachusetts Inst. of Tech.

SOLID SOLUTIONS AND GRAIN BOUNDARIES; TECHNICAL PROGRESS REPORT NO. 7, SCOPE II. B. L. Averbach, M. Cohen, P. Flinn, L. Seigle, and E. E. Underwood. June 30, 1951. 11p. (NYO-579)

Thermodynamic and x-ray diffuse scattering properties of Ni-Au solid solutions have been determined as part of a detailed study of the atomic arrangement in this system. The variation of emf of various Au-Ni alloys with temperature of the LiCl-KCl-NaCl-$NiCl_2$ electrolyte is shown. From these curves have been derived the activity and relative partial molal enthalpy and entropy of Ni. Curves of calculated diffuse x-ray scattering in Ni_4Au are shown, microphotometer traces of diffraction photograms of Cu_3Au and Ni_3Au_2 are compared, and Fourier transforms of diffuse intensities from Cu_3Au at 500°C, Ni_3Au_2 at 875°C, and Ni_3Au_2 quenched are plotted.

6210

North American Aviation, Inc.

THEORETICAL ESTIMATE OF THE EFFECT OF INTERSTITIAL ATOMS AND VACANCIES ON THE ELASTIC COEFFICIENTS OF SIMPLE METALS. G. J. Dienes. Issued Aug. 28, 1951. 15p. (NAA-SR-144)

A previously given theoretical treatment (NAA-SR-80; NSA 5-4589) of the change in elastic constants of simple metals caused by the presence of interstitial atoms and vacancies has been refined by evaluating the influence of relaxation around the lattice disturbances. The results indicate that relaxation has a small influence in Cu and in this system the presence of interstitial atoms results in a large increase in the elastic moduli even in the presence of relaxation. In Na, however, which has the more open body-centered cubic structure, the relaxation around an interstitial is large and this atomic readjustment reduces the effect of the interstitial to the magnitude of a bulk effect. (auth)

6211

Armour Research Foundation

PHASE DIAGRAMS OF ZIRCONIUM-BASE BINARY ALLOYS; REPORT NO. 4; JULY 1 - SEPTEMBER 1, 1951. Sept. 18, 1951. 42p. (COO-32)

Numerous data, tentative phase diagrams, and discussions are presented for the binary systems of Sn, Mo, Cu, W, Cr, Si, and Al with Zr. Attempts to prepare Zr-Mg alloys by arc melting were unsuccessful. 26 figures.

6212

Knolls Atomic Power Lab.

THERMAL RATCHETING; by J. E. Burke and Anna M. Turkalo. [nd] 20p. (AECU-1639)

The possibility is investigated that a mechanism in addition to thermal fatigue might operate to produce plastic deformation during thermal cycling, i.e., a "thermal ratchet" that depends on a combination of grain-boundary flow to relax the stress that develops between differently oriented grains upon raising the temperature and transcrys-

talline slip to relax the oppositely directed stress which develops on lowering the temperature. Thus, thermal cycling should produce a nonreversible distortion such that certain grains will change shape differently from their neighbors with a simultaneous displacement being produced at the grain boundary. Thermal-cycling tests on Zn bicrystals are reported which indicate the operation of a ratchet mechanism within a sufficiently high temperature range.

6213
SURFACE TENSION OF LIQUID METALS. R. A. Weale. Nature 168, 343(1951) Aug. 25.

A comparison is made between two mathematical expressions in the literature for the surface tension of liquid metals. The fact that both expressions are roughly satisfied is probably due to the inaccuracy of the experimental data, or to the fact that they are only different forms of the one given by Wen Po (Phil. Mag. 23, 33(1937).

6214
SOLUBILITY RELATIONSHIPS IN SOME OF THE TERNARY SYSTEMS OF REFRACTORY MONOCARBIDES. John T. Norton and A. L. Mowry. J. Metals (N.Y.) 3, 923-5(1951) Oct.

Isothermal sections of the pseudo-ternary carbide systems TiC-VC-ZrC, TaC-VC-ZrC, and NbC-VC-ZrC have been examined. The sections contain an inverted U-shaped two-phase field whose maximum extent is 77 molecular % for TiC, 64% for TaC, and 51% for NbC. Isoparametric lines were determined which show the curvature of the single-phase field and the direction of tie lines in the two-phase field. It was not possible to show any relationship between atom size and the extent of the two-phase field. (auth)

6215
EFFECT OF ALLOYING ELEMENTS ON THE ELEVATED TEMPERATURE PLASTIC PROPERTIES OF ALPHA SOLID SOLUTIONS OF ALUMINUM. O. D. Sherby, R. A. Anderson, and J. E. Dorn. J. Metals (N.Y.) 3, 643-52(1951) Aug.

The effect of various alloying elements (Mg, Cu, Zn, Ge, Ag) on the plastic properties of α solid solutions of Al at elevated temperatures was studied. Solid-solution alloying increases the plastic properties of Al at elevated temperatures by solid-solution strengthening. The effects are most pronounced in the Mg series, and the greatest improvement in flow stress occurs between ~300 and 425°K. The solid solution strengthening of the annealed metals decreases with increasing temperature, but the alloys exhibit greater relative rates of strain hardening than Al as the test temperature is increased. When binary Al alloys are strained and aged at 194 to 300°K they develop a yield point. This is attributed to a migration of dislocations to solute atoms during aging. 21 graphs.

6216
RELATION OF ANTIFERROMAGNETIC STRUCTURE TO THE BINDING ENERGIES OF SOME b.c.c. TRANSITION METALS. Yee-Chuang Hsu. Phys. Rev. 83, 975-9(1951) Sept. 1.

Zener's theory (Phys. Rev. 81, 440(1951)) of antiferromagnetic structure for V, Cr, Nb, Mo, Ta, and W is discussed from the point of view of binding energy. According to such a picture the large binding energies must come from coulomb interaction between cores. The importance of the outer d electrons in achieving large coulomb attraction is pointed out. A mathematical scheme for treating binding energy in the case of extensive overlap of cores is disucssed. By dismissing the contribution of a Wigner-Seitz type calculation, the remaining contributions to the binding energy of tungsten are calculated at the observed lattice constant. Results obtained demonstrate the importance of the coulomb attractive energy in an antiferromagnetic structure. (auth)

6217
ORIGIN OF THE CUBE TEXTURE IN FACE-CENTERED CUBIC METALS. Paul A. Beck. J. Metals 3, 474(1951) June. (Technical note)

The occurrence of the (100) [100] or "cube" texture upon annealing of cold-rolled Cu is discussed. By means of quantitative pole figure determinations it has been shown that the rolling texture of tough pitch Cu, which is almost identical with that of 2S Al, may be described roughly as a scatter around four symmetrical "ideal" orientations not very far from (123) [112]. In the case of Al, annealing leads to retainment of the rolling texture with some decrease of the scatter around the four "ideal" orientations, and to the appearance of the cube texture. A microscopic technique, revealing grain orientations by means of oxide film and polarized light, showed that the retainment of the rolling texture is achieved through two different mechanisms operating simultaneously, namely "recrystallization in situ," and the formation of strain-free grains in orientations different from their local surroundings, but identical with that of another component of the rolling texture. The conditions favorable for formation of the cube texture and the effects of alloying elements are discussed.

6218
PREPARATION OF METALLIC URANIUM AT THE BOUCHET PLANT OF THE COMMISSARIAT OF ATOMIC ENERGY. Charles Eichner, Bertrand Goldschmidt, and Paul Vertes. Bull. soc. chim. France (5) 18, 140-2(1951) Jan.-Feb. (In French)

Crude U oxides are dissolved in HNO_3. The solution is filtered, saturated with NH_4NO_3, and mixed with Et_2O under N_2 pressure. The impurities remain in the H_2O, uranyl nitrate being soluble in Et_2O. After separation, the salt is extracted with H_2O and precipitated hot by H_2O_2 as UO_4. UO_4 is decomposed to orange UO_3 by heating at 250 to 300°C, and UO_3 is reduced to UO_2 in a 1:4 mixture of H_2 and N_2 at 650°C. UO_2 is transformed into green UF_4 by action of anhydrous HF, NH_4F, or HF diluted to 40%. This last reaction takes place in 100-kg batches in containers lined with ebonite; the product is filtered through a polyvinyl chloride cloth and dried, first in air at 200°C and then, after crushing, in H_2 at 500°C to 0.3% H_2O. UF_4 is reduced by pure Ca shavings in CaF_2-lined, stainless-steel, vacuum-tight containers. The mixture is ignited by a heated Mg ribbon and, after reaction, cooled for 48 hr in an argon atmosphere. Pure Ca for this reaction is produced by reaction of CaO with Al and by distillation of the Ca under high vacuum. U is obtained in ingots of 35 to 40 kg, density 18.7 to 18.8; m.p. 1100 to 1130°C, having as impurities Fe, 0.005 to 0.02; Si, 0.010 to 0.05; Ca, 0.002 to 0.005; Mn, 0.0005 to 0.001%, H, 3 to 5 cc/100 g. This abstract appeared in Chem. Abstracts 45, No. 17, 7459e(1951) Sept. 10.

6219
THE PROBLEM OF GASES IN ALUMINUM AND IN ITS ALLOYS. Clovis Bradaschia. Bol. assoc. brasil. metais 7, 20-35(1951). (In Portuguese)

A survey of principal systems Al + gas shows that the presence of H is the principal factor determining the porosity of Al alloys. The mechanism of the formation of the porosities, the sources of H, methods of elimination of H from contaminated alloys, and measures against contamination of alloys by gases are discussed. (auth)

6220
STRUCTURAL STUDIES OF PLASTIC DEFORMATION IN ALUMINUM SINGLE CRYSTALS. N. K. Chen and C. H. Mathewson. J. Metals (N. Y.) 3, 653-60(1951) Aug.

Single crystals of high purity aluminum of various orientations were carefully documented after plastic exten-

sion. Special attention was given to the formation of slip lines, deformation bands, and asterism. An explanation for the geometry and mechanism of formation of deformation bands is considered. (auth)

6221

DESULPHURIZING ACTION OF TITANIUM IN STEELS. W. P. Fishel, William P. Roe, and James F. Ellis. J. Metals (N.Y.) 3, 674-6(1951) Aug.

This paper reports the distribution of sulphur between iron and titanium in Fe-Ti-S alloys and in Fe-Ti-C-S alloys. The compound TiS was found, which exists as a separate phase at temperatures below 1200°C. Titanium in steels reacts with sulphur in preference to carbon. (auth)

6222

THEORY OF GRAIN BOUNDARY MIGRATION RATES. David Turnbull. J. Metals (N.Y.) 3, 661-5(1951) Aug.

The relation between grain boundary migration rates and diffusion coefficients is derived on the basis of the absolute reaction rate theory. It is shown that in lattice self-diffusion the free energy of activation greatly exceeds that in grain boundary migration. A corollary of this is that in grain boundary migration the atomic mobility is many orders of magnitude larger than in lattice self-diffusion. In silver the free energy of activation for grain boundary self-diffusion equals that for grain boundary migration, within the experimental uncertainty. The apparent entropy of activation for boundary migration is much larger than for self-diffusion processes. An explanation for the unexpectedly large entropy of activation in boundary migration processes is given based on the concept that inclusions retarding boundary migration become less effective at elevated temperature due to their solution and coalescence. (auth)

6223

PREPARATION AND MAGNETIC PROPERTIES OF GADOLINIUM-MAGNESIUM ALLOYS RICH IN MAGNESIUM. Françoise Gaume-Mahn. Compt. rend. 232, 1815-16(1951) May 16. (In French)

The Gd-Mg alloys containing up to 65% Gd are paramagnetic; graphs of $1/X$ for 0 to 300°K are shown. A series of ferromagnetic (at low temperature) alloys exists between 70 and 100% Gd. Although the Gd-Mg phase diagram has not been determined, consideration of the Ce-Mg and La-Mg diagrams given by Vogel and Heumann (Z. anorg. u. allgem. Chem. 91, 277(1915); Metalliforschung 2, 1(1947)) makes probable the existence of $GdMg_8$, $GdMg_3$ (at the transition between paramagnetic and ferromagnetic behavior), $GdMg_2$, GdMg, and possibly Gd_4Mg.

6224

X-RAY DETECTION OF LONG-RANGE ORDER IN Ni_3Mn. B. L. Averbach. J. Applied Phys. 22, 1088-9(1951) Aug. (Letter to the editor)

A study was made of the ordered structure of Ni_3Mn. X-ray-diffraction photograms were made with FeK_α radiation in a Debye camera. A microphotometer trace of a film was produced which showed the superstructure lines (110), (210), (211), and the combination (300) and (221). These superstructure lines are consistent with a Cu_3Au ordered structure and a lattice parameter of approximately 3.59 A referred to the disordered face-centered-cubic structure.

6225

NEW SEGREGATION PHENOMENA IN METALS. M. T. Stewart, R. Thomas, K. Wauchope, W. C. Winegard, and B. Chalmers. Phys. Rev. 83, 657(1951) Aug. 1. (Letter to the editor)

Pb-Bi alloys containing radioactive Bi have been examined for segregation of the Po resulting from the decay of the Bi^{210}. Three types of segregation have been established: crystal boundary segregation, surface segregation, and inhomogeneous crystallization. The three effects are discussed, and two autoradiographs shown.

6226

VACUUM MELTING TITANIUM AND ZIRCONIUM. Steel 128, No. 25, 77-9(1951) June 18.

Techniques used by Titanium Alloy Manufacturing Division, National Lead Company, for melting Ti and Zr on a production basis are described. Research and development has been directed toward the use of a graphite crucible under vacuum or inert atmosphere, heated in a high-frequency induction furnace. Ti is melted in a tilting-type furnace producing ingots up to approximately 25 lb with carbon contamination ranging from 0.27 to 0.72%. Zr is melted in a bottom-pour type furnace producing ingots up to nearly 40 lb with carbon contamination ranging from 0.17 to 0.24% and Brinell hardness ranging from 170 to 229. The three types of induction furnaces employed are described. The basic procedure is similar for all three types of furnaces and consists of the following separate operations: crucible packing, degassing, and melting. Three graphs show the effects of time, temperature, and pressure on C contamination of Ti.

6227

HOW TO WORK TITANIUM AND ITS ALLOYS. Anderson Ashburn. Am. Machinist 95, No. 12, 145-53(1951) June 11.

The available information on Ti is summarized. Properties of Ti and Ti alloys, heat-treatment, machining, forging, bending and forming, welding and brazing, and descaling and cleaning are discussed.

6228

HOW TITANIUM BEHAVES AT TEMPERATURES TO 900°F. W. Lee Williams. Iron Age 167, No. 24, 81-4(1951) June 14.

Tests have been made on two commercial Ti ingots, one produced by induction melting in graphite and the other by arc melting in graphite. Both ingots were sectioned for hot forge-anneal and hot forge–cold work finishing treatments, but cold working of the induction-melted ingot was not successful. Tensile properties up to 900°F are reported. All of the materials showed a leveling off of the strength properties within the range 500 to 800°F. The induction-melted and arc-melted annealed materials had similar strength properties despite their difference in C content. The yield ratio, yield strength, and tensile strength of arc-melted Ti were increased by cold working. Despite very careful measurements, values for the elastic modulus in tension show some differences and scatter. Stress-rupture and creep curves are shown. An apparatus is described for comparing the steam-erosion resistance of various materials. It seems apparent that mild cold working offers a way to improve properties of some alloys beyond that gained by heat-treatment or alloying per se.

6229

TITANIUM RESISTS STRESS CORROSION. H. H. Uhlig and J. R. Cobb, Jr. Metal Progress 59, 816(1951) June. (Correspondence)

Tests have been made of the relative susceptibility of Ti and 18-8 stainless steel to stress-corrosion cracking in boiling saturated magnesium chloride and in 10% NaOH. The setup is described briefly in each case. After being immersed in boiling $MgCl_2$ for 4 hr, the two 18-8 specimens cracked at the region of maximum bending. The Ti specimens, on the other hand, were still not cracked when the test was discontinued after 62 days, and (except for a shallow pit on only one of the specimens) the visible corrosion was slight. Two specimens of each metal were prepared for tests in boiling 10% NaOH solution. At the end of 28 days, neither the Ti nor the 18-8 cracked. The Ti was corroded slightly; weight loss was computed at 1.5 $mg/dm^2/day$,

and the surface was slightly tarnished. On the other hand, the 18-8 turned black, but nevertheless corroded on the order of only 15 mg/dm²/day.

6230

ARC MELTING OF TITANIUM METAL. S. F. Radtke, R. M. Scriver, and J. A. Snyder. J. Metals (N.Y.) 3, 620-4 (1951) Aug.

An automatic, continuous casting arc furnace employing a nonconsumable electrode and a d-c arc has been constructed and operated successfully for Ti. Commercially pure sponge can be melted at a rate of 0.6 to 1.0 lb/min with a power input of 64 to 100 kw. Alloys can be melted at an even higher rate, provided that they have a lower melting point than pure Ti. A comparison of the properties of arc and induction-melted titanium indicates that where high ductility, formability, and toughness are required, arc-melted metal is preferable.

6231

FERROMAGNETISM OF THE ALLOY $FeBe_2$. André J.-P. Meyer and Pierre Taglang. Compt. rend. 232, 1545-6(1951) Apr. 23. (In French)

$FeBe_2$ has a Curie point at 643°C and a temperature of magnetic isotropy of 468°C. The magnetic saturation is 163.3 cgs units/molecule, corresponding to a moment of 2.24 μ_B. The structure is hexagonal and has a large magnetic hardness; hardness coefficient = 415. Above the Curie point $FeBe_2$ exhibits a normal paramagnetism; the paramagnetic Curie point is 666°C and the molecular Curie constant is 0.660. The ferromagnetism of $FeBe_2$ may be considered an argument in favor of an atomic orbital contraction in this type of alloy.

6232

BONDING OF TITANIUM CARBIDE WITH METAL. Walter J. Engel. Metal Progress 59, 664-7(1951) May.

An investigation was made to study the bonding of TiC with various elements and to accumulate information regarding the mechanism of bonding. A muffle type of furnace employing a He atmosphere was used in fusing the powdered elements in carbide cups. Metallographic examinations of sectioned specimens were made in order to determine the type of bond between the TiC and the elements. Of the 15 elements tested, only Ni, Co, Cr, and Si bonded with solid, high-density TiC. Ni and Co produced the most extensive bonds; Cr and Si were less effective in penetrating and forming extensive interlocking networks. The appearance of small, angular-shaped precipitates in the Ni-rich and Co-rich zones somewhat substantiated the premise that there is some solubility (limited perhaps) of TiC in Ni and Co at temperatures above their melting points. Ni, Co, and possibly Cr appear to have some promise as binder materials for sintered TiC bodies.

6233

ON THE FORMATION OF A TITANIUM SLAG IN A SELECTIVE REDUCING FUSION OF ILMENITE. William Freundlich. Compt. rend. 233, 413-15(1951) July 30. (In French)

Using a proper proportion of carbon and Na_2CO_3, the latter acting as a flux, Fe and Ti of ilmenite can be separated almost quantitatively, provided the temperature is kept between 1210 and 1340°C. A system of two liquid layers is obtained, viz., a slag which contains the Ti, and a melt. (auth)

6234

PROCESSING TITANIUM. Frank Charity. Modern Machine Shop 168, 169-79(1951) Aug.

Physical and metallurgical properties of titanium and titanium alloys and production methods are discussed.

MINERALS AND MINERALOGY

6235

ON THE AGE OF THE EARTH. G. V. Voitkevich. Doklady Akad. Nauk S.S.S.R. 77, 461-4(1951). (In Russian)

From isotopic ratios in Pb minerals, Holmes (Nature 157, 680(1946)) has found for the age of the earth the value 3.3×10^9 yr. However, since those minerals are mostly associated with granitic rocks, the above value gives just the age of the granitic layer of the earth's crust, which is generally regarded as of secondary origin and, whatever the nature of that origin, may have been formed rather late in the opening phases of the history of earth as a cosmic body. An attempt is made here to calculate the maximal value of the age of the earth as a planet by determining the age of U^{235}, presumably formed under cosmic conditions other than those possible on earth. The value found is 5×10^9 yr. It is corroborated by the following results of computations of the age of meteorites: age of U^{235} in meteorites, as found from the Pb-isotope contents, is 5.7 to 6×10^9 yr; age of iron meteorites, as found by the He method, is 5.3×10^9 yr.

6236

DIFFERENTIATION OF XENOTIME, ZIRCON, AND SPHENE BY X-RAY ABSORPTION. René Coppens. Compt. rend. 232, 1681-2(1951) Apr. 30. (In French)

Mineralogists often find difficulty in distinguishing xenotime (YPO_4) from zircon ($ZrO_2.SiO_2$) because of similar physical and mineralogical properties. The difference in absorption of x rays of wavelength 0.71 A (between the absorption edges of Zr and Y) may be used for this purpose. Minerals such as sphene ($CaTiSiO_5$) which do not absorb in this region may be distinguished by varying the x-ray wavelength and observing the relative behavior of the three substances.

6237

THE EXPLORATION AND DEVELOPMENT OF CANADIAN URANIUM DEPOSITS. B. S. W. Buffam and E. B. Gillanders. Precambrian 24, No. 7, 21,23(1951) July.

The methods used by Eldorado Mining and Refining, Ltd., in systematic Geiger-counter surveying of a U prospect, test drilling, shaft sinking, lateral drilling and crosscutting, sampling, and stoping are described briefly.

6238

A FURTHER INVESTIGATION OF THE RADIOACTIVITY OF THE ROUND LAKE AND ELZEVIR BATHOLITHS. H. A. Slack and K. Whitham. Trans. Am. Geophys. Union 32, 44-8(1951) Feb.

A brief description is given of a γ-ray counter which has been used in field surveys. The detector unit contains 2 trays of commercial G-M γ tubes, 6 in the upper and 5 in the lower, and 2 followers. Pulses are fed through a 100-ft cable to the anticoincidence mixer and counting unit mounted in a truck. Noncoincident pulses from the bottom tray alone were recorded, eliminating 70% of the cosmic background. The operation of the counter in two batholiths is discussed. Results are presented and compared with those obtained by a laboratory α-counting method of prepared hand specimens. The locations of radioactivity on and around the Round Lake and Elzevir batholiths are shown diagrammatically.

6239

USES OF NUCLEAR PHOTOEMULSIONS IN MINERALOGY AND GEOLOGY. F. G. Houtermans. Naturwissenschaften 38, 132-7(1951) Mar. (In German)

Various photographic methods of investigation of the radioactivity of minerals and rock samples are outlined. One group of procedures permits the determination of the content of α emitters in samples by the study of the tracks;

among these procedures are autoradiographic determinations of U and Th, photographic determinations of emanation swept out from solutions of minerals, and the study of images left on the plate by drops of solutions. Another problem, solved by various autoradiographic techniques, is the localizing of radioactive centers within the texture of a rock or the structure of a mineral; in this way it has been found that in many granites the accessory minerals zircon, apatite, and titanite, which are present in small quantities only, are responsible for the rock's radioactivity (zircon often contains 2.4% U); it has also been observed that radioactive material is very often accumulated along microscopic clefts in minerals and rocks. This latter circumstance furnishes an explanation and a correction of certain inexactitudes and contradictions in aged determinations of rock formations by the known radioactive-transformation methods. The use of mechanically isolated zircon inclusions for age determinations of rocks by the U-Pb method is suggested.

TRACER APPLICATIONS

6240

APPLICATION OF RADIOACTIVE TRACER TECHNIQUES TO THE STUDY OF DIFFUSION IN SOLIDS. Jean-Claude Hutter. Bull. soc. chim. France (5) 18, 45D-52D(1951) July-Aug. (Review, in French)

The theory of diffusion in solids is summarized, tracer and autoradiographic techniques are reviewed, equations for calculating the diffusion coefficient are derived, and the breadth of this field of research is suggested. 94 references.

6241

A STUDY OF ENAMEL ADHERENCE USING RADIOACTIVE ISOTOPES. W. N. Harrison, J. C. Richmond, J. W. Pitts, and S. G. Benner. Paper presented at the 53rd Annual Meeting of the American Ceramic Society, Chicago, Apr. 24, 1951.

An abstract of this paper appeared in Am. Ceram. Soc. Bull. 30, 94(1951) Mar. and is reproduced here in its entirety.

Enameling-iron blanks were rendered radioactive by irradiating them in the atomic pile at Oak Ridge. These radioactive specimens were coated with two typical one-frit ground-coat enamels, identical in composition except that one contained normal amounts of the adherence-promoting oxides and the other contained none. Specimens of each enamel were fired under conditions selected to give underfired, normally fired, and overfired coatings, respectively. Metallographic sections of these specimens were prepared, from which autoradiographs were made, to determine the amount of radioactive iron oxide formed during firing, the portion retained at the interface, and the distribution of the remainder in the enamel layer. These findings were correlated with the adherence of specimens prepared under the same conditions as determined with the PEI Adherence Meter.

6242

VARIABLES ENCOUNTERED IN TRACER EXPERIMENTS IN METALLURGY. C. Dean Starr, John R. Lewis, and Thomas J. Parmley. Metal Progress 59, 673-80(1951) May.

In order to determine the magnitude of the variables encountered in a tracer analysis, a series of diffusion experiments were conducted by plating Co^{60} on cylindrical steel samples. Variables include apparatus and its calibration, background counts, statistical fluctuation, half life of isotope, condition and geometry of sample, absorption, and coincidence counting. Methods of controlling these variables are considered.

PHYSICS

6243

Brookhaven National Lab.

QUARTERLY PROGRESS REPORT; APRIL 1–JUNE 30, 1951. Issued Aug. 1951. 124p. (BNL-117)

Separate abstracts have been prepared on the following sections of this report: Physics, p.1-16, 69-81; Instrumentation and Health Physics, p.17-25, 61-2; Accelerator, p.26-30; Chemistry, p.31-43, 49-61, 63-8; Reactor Science and Engineering, p.82-93; and Biology and Medicine, p.44-9, 94-121.

6244

Brookhaven National Lab.

PHYSICS, p.1-16, 69-81 of QUARTERLY PROGRESS REPORT; APRIL 1–JUNE 30, 1951. Issued Aug. 1951. 29p. (BNL-117(p.1-16, 69-81))

Results of studies in various stages of completion and preparation for publication are reported. The neutron-scattering cross section of Be at 500°K is shown graphically for neutron wavelengths of 7 to 25 A. A sample page from a compilation of neutron cross sections, now available in preliminary form for criticism, is illustrated. Fast-neutron-capture cross sections corrected for binding energy of the individual isotopes are plotted, and some comments are made about the relation of these values to "magic" numbers. A value of 2.7223 ± 0.004 Mev for the Q-value of the reaction $C^{12}(d,p)C^{13}$ has been obtained with the heavy-particle spectrometer. A graph of the α-γ angular correlation in the reaction $F^{19}(p,\alpha)O^{16*}(\gamma)O^{16}$ at the 340-kev resonance is shown. The total n-p cross sections for 14.10-Mev neutrons of C and H have been measured as 1.279 ± 0.004 and 0.689 ± 0.005 barns, respectively, and the incompatibility of these figures with the equality of n-p and p-p forces on the basis of a square-well potential is mentioned. Pulse-height distributions produced by neutrons on terphenyl-xylene liquid scintillation counters are shown. Detailed reports on the decay schemes of 60-day I^{125} and 5.2-min Cu^{66} are presented, preparation of >200-day A^{42} by neutron irradiation of A^{40} is mentioned, and testing of the neutron-diffraction apparatus is described.

6245

PHOTONS AND ELECTRONS. K. H. Spring. London, Methuen and Co., Ltd., 1950. 108p.

A review of this book appears in Proc. Phys. Soc. (London) 64A, 436-7(1951) Apr. and is reproduced here in part.

This monograph gives a simple account of the theoretical results which have been obtained for the main high-energy processes involving photons and electrons, viz., the photoelectric effect, Compton scattering, bremsstrahlung, and pair production. The theoretical cross sections are in every case compared with the experimental values, and particular emphasis is placed on the angular distributions of the various outgoing particles. The last chapter contains an elementary account of the results of the cascade theory of the soft component of cosmic radiation, including a discussion on the

lateral spread of the showers. The mathematical development is avoided, and there is no attempt to introduce the concepts of a quantized field theory. The variation of the cross sections with energy and angle is fully illustrated, and there are useful tables of data.

6246
DUST IMAGES OF GAS CURRENTS PRODUCED BY THERMODIFFUSION. Klaus Clusius and Horst Meyer. Z. Naturforsch. 6a, 401-2(1951) July. (In German)

Experiments illustrating gas streams concomitant with the thermodiffusion process are described, in which convection currents produced by a H flame in a glass container, under pressures of 30 to 200 mm Hg, are made visible through the presence of a dust of NaCl vaporized by the flame. (auth)

6247
PULSED AIR CORE SERIES DISK GENERATOR FOR PRODUCTION OF HIGH MAGNETIC FIELDS. Robert I. Strough and Erwin F. Shrader. Rev. Sci. Instruments 22, 578-82 (1951) Aug.

For possible use in a cloud chamber, betatron, or synchrotron, a successful prototype generator has been built and its performance compared with the theoretical operation of such a device. It is capable of storing, as mechanical energy, 29,000 j when operating at 20,000 rpm. When operated under short-circuit conditions, a current pulse of 56,000 amp maximum is obtained in the single-turn series field coil. Liquid mercury brushes are used; the starting of the flow of Hg in the brush system serves to start the generator in operation.

6248
PHYSICS IN CANADIAN UNIVERSITIES, p. 21-35 and supplement of PHYSICS IN CANADA, 1951. Toronto, Canadian Association of Physicists, 1951.

Progress during 1951 in the fields of nuclear physics, solid-state physics, spectroscopy, theoretical physics, etc., at each of the Canadian universities is summarized briefly.

ASTROPHYSICS

6249
THE ISOTOPE He^3 IN STARS. APPLICATION TO THE THEORY OF NOVAE AND WHITE DWARFS. Evry Schatzman. Compt. rend. 232, 1740-1(1951) May 7. (In French)

In stars of sufficiently low temperature and high density, He^3 will accumulate in small concentration from the $H^1 + H^1 \rightarrow D^2 + \beta$ and $D^2 + H^1 \rightarrow He^3$ reactions. The probability of a further reaction, $He^3 + He^3 \rightarrow He^4 + p + p$ would be high. It is shown that 10^{-2} g of He^3/g of matter of density 1000 can start a detonation wave of 700-km/sec velocity at a 10^8 °K temperature, resulting in a nova. In white dwarfs the He^3 will be short-lived and will not affect the stability.

COSMIC RADIATION

6250
BAROMETRIC EFFECT AND DIURNAL VARIATION IN EXTENSIVE ATMOSPHERIC SHOWERS. Anselm Citron. Z. Naturforsch. 6a, 334-5(1951) June. (Note: in German)

A study of the correlation between the barometric effect in extensive atmospheric showers and their mean density showed that, contrary to Cocconi's theory (Phys. Rev. 72, 264(1947)), the barometric effect increases with the shower's density. Furthermore, no appreciable diurnal variations were observed in extensive atmospheric showers at 1230 m altitude; Daudin et al., (J. phys. radium 10, 394(1949)) have registered such variations at 2860 m altitude.

6251
THE DISINTEGRATION OF LIGHT NUCLEI BY COSMIC RAYS. P. E. Hodgson. Phil. Mag. 42, 955-7(1951) Aug. (Correspondence)

Sandwich emulsions composed of alternate layers of G5 emulsion and pure gelatin were exposed to cosmic rays on the Jungfraujoch and analyzed with the purpose of comparing the average charge emitted from the disintegrations in the gelatin with the average charge on the elements which constitute the gelatin. The corrected value of the average charge per star emitted as singly or doubly charged particles is 5.96 ± 0.25e. An average charge per star of 0.87 ± 0.25e is therefore emitted as short-range particles which mostly remain in the gelatin layer and escape detection. Assuming they have an average charge of 4e, the number of such fragments becomes 0.22 ± 0.006 per star. One such particle was observed which is of the correct order of magnitude in view of the unfavorable conditions of observation.

6252
THE CASCADE PRODUCTION OF COSMIC RAY STARS AND THE RELATIVE NUMBER OF CHARGED AND UNCHARGED PARTICLES. Sir George Thomson and P. E. Hodgson. Phil. Mag. (7) 42, 978-89(1951) Sept.

A calculation has been made of the consequences of assuming that stars are produced in a cascade process by charged and uncharged particles according to a very simple law. The constants in this law can be chosen to give agreement with experiment to the extent to which the quantities are known and also fall within the ranges that are a priori permissible. It does not appear possible to determine them with much accuracy from existing data, but it seems that a fair proportion of the stars with less than five prongs are due to primaries of fairly high energy. (auth)

6253
ON A NON-ELECTROMAGNETIC CASCADE IN COSMIC-RAY SHOWERS. S. A. Azimov, M. I. Podgoretskiĭ, I. L. Rozental', and K. P. Ryzhkova. Zhur. Eksptl'. i Teoret. Fiz. 21, 574-80(1951) May. (In Russian)

The nuclear cascade mechanism of the "electron-nuclear" showers has been established by Zatsepin (Doklady Akad. Nauk S.S.S.R. 67, 993(1949)) and by Birger et al., (Zhur. Eksptl'. i Teoret. Fiz. 19, 826 (1949)). Present in high-energy showers associated with extensive atmospheric showers, secondary "nuclear-active" particles have also been observed in showers of lesser energy. New experiments confirming this latter result are described here. Performed at 4700 m altitude and consisting of coincidence measurements involving Pb, C, and Al filters, they furnished certain data on the quantitative aspects of the nuclear cascade process.

6254
GENERATION OF ELECTRON-NUCLEAR SHOWERS IN LEAD AND GRAPHITE. S. A. Azimov and V. V. Guseva. Zhur. Eksptl'. i Teoret. Fiz. 21, 569-73(1951) May. (In Russian)

Several Russian writers have described "electron-nuclear" showers which consist of elementary particles of various nature and which are generated as a result of interaction with matter of "nuclear-active" particles of high energy. Experiments are described here in which such showers were produced, at 3860 m altitude, in Pb and C plates in a cloud chamber. An estimate is made of the range of the penetrating component of the showers and of the number of secondary "nuclear-active" particles. 6 photographs.

6255
THE DIFFERENTIAL CROSS SECTION FOR HIGH ENERGY NUCLEON-NUCLEON COLLISIONS. H. S. Green and H. Messel. Phys. Rev. 83, 842-3(1951) Aug. 15.

A method for deriving the differential from a given total cross section for inelastic nucleon-nucleon collisions in the laboratory system is given in an attempt to account

theoretically for the lateral and angular spread of the penetrating particles in high-energy cosmic-ray showers.

6256

EVIDENCE OF MULTIPLE MESON PRODUCTION. Nature 168, 73(1951) July 14. (Letter to the editor)

Indirect evidence of multiple meson production by a single primary proton was obtained by the absence of azimuthal meson-intensity variation. Four triple-coincidence-counter telescopes, each differing in azimuth by 90°, were used at sea level, geomagnetic latitude 43.5°S, the middle counter in each telescope having 5 cm of Pb on either side of it. The angle subtended by each telescope was 13 by 3.5°, the larger angle being in the vertical plane, and the zenith angle was 60°. Intensity measurements were made at azimuth intervals of 30°.

6257

AVERAGE NUMBERS FOR THE DEVELOPMENT OF THE NUCLEON COMPONENT OF THE COSMIC RADIATION IN AIR. H. Messel. Proc. Phys. Soc. (London) 64A, 726-32 (1951) Aug.

Comprehensive results of a theoretical study of the behavior of the nucleon component of cosmic radiation in air are presented in graphic form for nucleons with energies equal to or greater than 500 Mev, based on calculations using a new cross section for nucleon-nucleon collisions. The results obtained are in good agreement with existing experimental observations.

6258

THE ABSORPTION OF COSMIC RADIATION AT HIGH ALTITUDES. Martin A. Pomerantz. Phys. Rev. 83, 459-60 (1951) July 15. (Letter to the editor)

The results of direct measurements of absorption of primary cosmic-ray particles by 7.5 cm and by 18 cm of Pb are given in the form of intensity (quadruple coincidences per minute) vs. altitude curves. Whereas the earlier comparision based upon the usual arbitrary normalization at sea level had indicated an absorption in 18 cm of Pb amounting to 40% near the "top of the atmosphere," the present results show that actually 29% of the primary particles are stopped in the sense that neither the primary nor any of its progeny created within the apparatus has sufficient residual range and proper direction of propagation to activate the coincidence train.

6259

THE EMISSION OF RADIOACTIVE NUCLEI IN COSMIC RAY STARS. E. Pickup and L. Voyvodic. Can. J. Phys. 29, 263-73(1951) July.

It has been found that a certain proportion of the fragments emitted in cosmic ray stars formed at about 85,000 ft consists of radioactive nuclei, i.e., in electron sensitive photographic emulsions, tracks of electrons with energies of several mega electron volts can be seen originating at the end of the track of the fragment. Details of such events are given, together with energy measurements for the disintegration electrons made by the multiple Coulomb scattering method. The significance of the results and possible identification of the fragments are discussed. (auth)

6260

ON THE EAST-WEST EFFECT OF THE COSMIC-RADIATION IN THE UPPER ATMOSPHERE. Syûzô Ogawa and Yukio Nagahara. Progress Theoret. Phys. (Japan) 5, 428-36(1950) May-June.

The fact that in the upper atmosphere there is symmetry of the east-west intensity of the cosmic ray brings a difficulty to the proton-primary hypothesis, which is assumed from the experimental results of the east-west asymmetry on each latitude from sea-level to an altitude of 10,000 m. To remedy the situation, Arley (Proc. Roy. Soc. (London) 173A, 91(1939)) assumed that there exist negative protons in the primaries. But the mechanism by which the negative proton produces the soft component is not known. In order to make clear to what extent the problem of the east-west effect can be solved from the standpoint that is now accepted—that is, a primary proton gives a π meson and the π meson decays into a μ meson which gives the soft component by disintegration—the angular distribution between the primary proton and the produced soft component has been investigated. (auth)

6261

ENERGY DISTRIBUTION OF THE PRIMARY COSMIC RADIATION. H. V. Neher. Phys. Rev. 83, 649-50(1951) Aug. 1. (Letter to the editor)

Correlation of the results of many experiments on primary cosmic-ray energies at various altitudes and latitudes has led to formulation of the empirical formula $N(E) = 0.048\ E^{1/2}/(1 + 0.09\ E^{4/3})^{3/2}$ for the differential number distribution of primary particles of energy E.

6262

ON THE DIURNAL VARIATION OF EXTENSIVE AIR SHOWERS OF HIGH DENSITY AT 3500 m ABOVE SEA LEVEL. C. Ballario, B. Brunelli, A. De Marco, and G. Martelli. Phys. Rev. 83, 666-7(1951) Aug. 1. (Letter to the editor)

A series of experiments have been conducted on extensive air showers at magnetic latitude 47°N. The various types of coincidence are tabulated, and the G-M counter arrangement is described. The procedure for analysis of the data is the main concern of the paper, rather than an interpretation of the results.

6263

THE CRAB NEBULA AS AN OBSERVED POINT SOURCE OF COSMIC RAYS. Y. Sekido, T. Masuda, and S. Yoshida. Phys. Rev. 83, 658-9(1951) Aug. 1. (Letter to the editor)

The diurnal variation of cosmic rays 1200 m water equivalent underground has been studied from the data obtained by Nishina et al. (Phys. Rev. 59, 401(1941); 76, 1733(1949)) from Oct., 1939, to July, 1940. If the period of observation is divided into 3 parts (~ 3 mo each), the sidereal times of maximum intensity are 4 hr, 5 hr, and 7 hr, respectively. When the effective solid angle of the measuring instrument is projected on the celestial sphere, it is seen that the Crab nebula stays in the solid angle during the period from 2 to 8 hr. There was no considerable effect in cosmic-ray intensity in the directions of Cygnus and other point sources of cosmic noise.

6264

MEASUREMENTS OF THE STAR-PRODUCING RADIATION WITH A SCINTILLATION COUNTER. E. G. Michaelis and E. P. George. Proc. Phys. Soc. (London) 64A, 662-3(1951) July. (Letter to the editor)

For the purpose of a preliminary investigation of cosmic-ray stars a counter has been constructed consisting of a crystal of 1.5 cm^3 of KI activated with 1% TlI. This was attached to a photomultiplier of type RCA 931A specially selected for low noise, which was operated at 100 v per stage derived from a stabilized power supply unit Model 1007. The number of output pulses corresponding to an energy release in the crystal exceeding 38 Mev were recorded over a period of 6 months, and the variation of counting rate under lead absorbers of different thicknesses was measured. The results show that the adsorption was exponential. The range of the radiation recorded was 350 ± 40 g/cm^2 of lead. The range of the star-producing radiation in lead is known to be 310 ± 20 g/cm^2. Comparison of the two figures strongly suggests that the events recorded by the scintillation counter are in fact cosmic-ray stars produced in the phosphor and particles from stars occurring in the surrounding material.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

6265
ASTERISM PRODUCED IN POLYCRYSTALLINE ALUMINUM SPECIMENS BY BENDING. R. Calvo and L. Rivoir. Anales real soc. españ. fís. y quím. 47A, 5-6(1951) Jan.-Feb. (In Spanish)

A bent piece of Al consisting of crystals about 1 cm wide showed a modified Laue diagram in which dots were replaced by streaks of a banded appearance (banded asterism). This picture disappeared with the unbending of the specimen. Since no recrystallizations were observed, the phenomenon is ascribed to a breaking up of the crystal into nondeformed fragments separated by portions of distorted substance.

ELECTRONS

6266
SECONDARY EMISSION OF ELECTRONS FROM LIQUID METAL SURFACES. James J. Brophy. Phys. Rev. 83, 534-6(1951) Aug. 1.

The secondary emission ratio as a function of primary energy is determined for targets of bismuth, gallium, lead, and mercury for the metals in both the liquid and solid state. The secondary emission characteristics for liquid surfaces are shown to be very nearly like those for solid surfaces, and in general the shape of the secondary efficiency curves for these materials is similar to those for other pure metals. A comparison of the observed maximum secondary ratios with predicted values is made. (auth)

6267
ON RELATIVISTIC QUANTUM MECHANICS AND THE MASS OPERATOR. Walter Wessel. Phys. Rev. 83, 1031-7(1951) Sept. 1.

The theory of the electron developed by Bopp, Hönl, and the author is discussed in relation to the relativistic wave equation of Gelfand and Yaglom (Doklady Akad. Nauk S.S.S.R. 59, 655(1948)), with particular regard to the infinite, hermitian representations of its matrix apparatus. It is shown that the ambiguity left in the work of the Russian authors is completely removed in our formulation. Only the form of the mass operator, which depends, in Bopp's interpretation, on the cut-off function in the Born-Bopp variation principle, remains uncertain. It is shown that in the infinite representations the mass operator must necessarily depend on one of the invariants (K) of the momentum tensor, because otherwise its eigenvalues would have a point of accumulation at zero. In order to avoid this possibility, the diagonal transformation of the invariant in question is accomplished, and a necessary condition for the analytic form of the mass operator is established, which considerably restricts its choice. (auth)

6268
THE ANOMALOUS SPIN GYROMAGNETIC RATIO OF THE ELECTRON. S. Koenig, A. G. Prodell, and P. Kusch. Phys. Rev. 83, 687-8(1951) Aug. 1. (Letter to the editor)

Preliminary results of a new measurement of the anomalous spin gyromagnetic ratio of the electron are presented. Measurements were made of transitions between Zeeman levels of the hyperfine structure of atomic hydrogen in a fixed magnetic field and of the precession frequency of protons in a water sample placed in the same magnetic field. By combining these results with recent measurements by Gardner and Purcell (Phys. Rev. 76, 1262(1949)) of the ratio of the cyclotron frequency of the electron and the nuclear resonance frequency of the proton in a magnetic field, the authors found the anomalous spin gyromagnetic ratio to be $2(1.001145 \pm 0.000013)$, in good agreement with the theoretical result $2(1.0011454)$.

6269
THE REVERSE ACTION OF THE RADIATION IN THE NEW FORMULATION OF THE ELECTRON THEORY OF WHEELER AND FEYNMAN. Helmut Steinwedel. Z. Naturforsch. 6a, 173-7(1951) Apr. (In German)

Feynman's (Phys. Rev. 74, 939(1948)) new formulation of the divergency-free classical theory of the electron, given by Wheeler and Feynman (Revs. Modern Phys., 17, 157 (1945); 21, 425(1949)), can be modified in such a way as to make only retarded fields appear in the equations of motion. From the retarded self-field of the electron both the electron's electromagnetic mass and the usual expression for the radiation force can be directly derived. Furthermore, the presence in the equations of higher-order derivatives with respect to time makes it possible to avoid "divergent motion types" discovered by Dirac, Eliezer (Revs. Modern Phys. 19, 147(1947)), and others. (auth)

6270
A MODEL INTERPRETATION OF THE ADDITIONAL MAGNETIC MOMENT OF THE ELECTRON. J. Brandmueller. Naturwissenschaften 38, 139(1951) March. (In German)

Schroedinger (Sitzber. preuss. Akad. Wiss, 418(1930)) has pointed out that the Dirac equation implies a "trembling" motion of the electron on its orbit, which accounts for the electron's spin and magnetic moment. Hoenl (Ann. Physik 33, 565(1938); Z. Physik 116, 153(1940)) described these ideas in a model in which the electron revolves, with the velocity of light c, upon an epicycle of radius $\hbar/2$ mc, the center of the epicycle lying on the orbit. Quantum-electrodynamical calculations of the electron's magnetic moment by Schwinger (Phys. Rev. 73, 416(1948)) and Luttinger (Phys. Rev. 74, 893(1948)), in good agreement with the measurements of Kusch and Foley (Phys. Rev. 74, 250(1948)), represent this magnetic moment as a sum of two terms, one of which involves Hoenl's epicycle radius, while the other contains the classical radius of the electron r_e. It is shown in the present work that this latter term is conveniently rendered in Hoenl's model by assuming a "hyper-trembling" motion, reflected in a secondary epicycle of radius r_e around which the electron revolves with the velocity $c/2\pi$.

GASES

6271
THERMAL DIFFUSION IN HYDROGEN-WATER VAPOR MIXTURES. E. Whalley. J. Chem. Phys. 19, 509-10 (1951) Apr.

An error in the report on thermal diffusion in $H_2 - H_2O$ vapor mixtures by Shibata and Kitagawa (J. Faculty Sci. Hokkaido Imp. Univ. Ser. III, 2, 223(1938)) is recognized and recalculated values are tabulated.

6272
ENTROPY OF A MIXTURE OF GASES IN EXCITATION AND IONIZATION EQUILIBRIUM. Perrine Dumezil-Curien. Compt. rend. 232, 1471-2(1951) Apr. 16. (In French)

A formula established by Schatzman (Bull. classe sci. Acad. roy. Belg. 34, 748(1948)) for the entropy of a gaseous mixture in ionization equilibrium has been generalized to take the excited states of the atoms and ions into account.

INSTRUMENTS

6273
Atomic Energy Project (Canada)
A.E.P. 908 SCALER; PROVISIONAL INSTALLATION AND OPERATING INSTRUCTIONS; by W. D. Howell. Oct. 1949. 13p. (IM-5)

6274
National Standards Lab. (Australia)
THE DESIGN OF A PRECISION DOUBLE MONOCHROMATOR. W. H. Steel. Jan. 1951. 48p. (PA-14)

The design of a prism monochromator of high light output and narrow spectral band width for use in precision spectrophotometry is discussed, with theoretical treatment of the optics of dispersing prisms at angles other than those for minimum deviation and of a mechanical system to give automatic wavelength and slit-width adjustment using a drive graduated linearly in wavelength. Appropriate numerical values are discussed after each stage of the theoretical investigation. The monochromator has been designed to give an effective band width of 1 A for wavelengths from 2000 to 8000 A. This region is covered by using quartz prisms from 2000 to 4000 A and glass prisms from 3800 to 8000 A. The band width of the instrument is variable from 1 to 100 A.

6275
Radiation Lab., Univ. of Calif.
ORBITS IN A PROPOSED SPHERICAL ELECTROSTATIC SPECTROMETER; by A. A. Garren. Aug. 27, 1951. 12p. (UCRL-1451)

The construction of an ion-energy spectrometer out of a spherical condenser has been proposed. Source and detector would be placed between the two spherical metal shells, which are at a potential difference from each other. The energy of the ions would be measured by adjusting the potential difference between the condenser plates until the ions are caught by the detector. In this paper the orbits in such an instrument and its focusing properties are investigated theoretically. Equations are derived which indicate that the instrument should be designed for the maximum energy which one wants to observe. In order to make it as small as possible the field in the gap should be as large as possible, perhaps as large as the sparking field. The potential difference between the electrodes controls the separation of the electrodes, which in turn defines the angular spread at the source seen by the detector. A numerical example is given to illustrate the theory.

6276
Brookhaven National Lab.
NEUTRON FLUX SCANNER; by W. Bernstein, E. H. Foster, and J. J. Floyd. [nd] 12p. (AECU-1621)

A method of measuring the neutron-flux distribution in the experimental holes through a reactor is described. A Cu wire is strung through one of the holes and irradiated. The wire is removed from the reactor into a lead pig. It is wound on a reel by a motor drive which is set to shut off after pulling a length of wire corresponding to the reactor dimensions. After decaying to a suitable counting level, the wire is pulled past a cylindrical proportional counter mounted in the roof of the pig. The counting rate is plotted on a pen recorder giving a profile of the flux distribution across the reactor. Profiles of several of the holes of the Brookhaven reactor are given. 7 figures.

6277
Brookhaven National Lab.
A SIMPLE ION-GAUGE REGULATOR; by Paul I. Richards and W. Ansel Tuthill. Aug. 9, 1951. 3p. (AECU-1629)

A regulator for the electron-emission current in an ionization gage, consisting essentially of two filament transformers and a miniature thyratron, is diagramed. The thyratron as transformer-loading tube provides for higher plate current than a "hard" tube yet requires only a few volts for control. As a result, loop gains even higher than those of commercial circuits can be obtained with but one tube. The circuit constants are given for a VG1A ion gage running at 2-ma-emission current with 225 v grid to filament and −35 v filament to plate.

6278
Radiation Lab., Univ. of Calif.
PULSE HEIGHT DISTRIBUTION ANALYZER II; by William E. Glenn. Aug. 21, 1951. 15p. (UCRL-1432)

In a previous report (UCRL-250) a method of pulse-height analysis was described which employed a special cathode-ray tube as differential discriminator. Such a tube has now been made commercially, and a 20-channel pulse analyzer using this tube has been in use for several months. This article describes the commercially available tube, the improved circuits of the completed instrument, and its operating characteristics. A 60-channel pulse analyzer now under construction is also explained briefly. It employs five diode discriminators and a single 10-channel cathode-ray-tube pulse analyzer in cascade.

6279
Brookhaven National Lab.
A NEW TYPE AUTOMATIC RADIOASSAYER; by Saul J. Harris and Anthony Del Duca. [nd] 15p. (AECU-1632)

A mechanical sample changer and associated electronic circuits have been developed for automatic radioassay of large quantities of similar samples. The samples in lucite holders are stacked vertically and are shifted by a continuously rotating driving wheel to a counting position where an integrating ratemeter records the activity. The samples are then restacked in order. (auth)

6280
Ames Lab.
MEASUREMENT OF THE D. C. RESISTANCE OF SELENIUM AND COPPER OXIDE RECTIFIERS BELOW ROOM TEMPERATURE; by D. M. Grimes and Sam Legvold. Sept. 27, 1951. 14p. (ISC-172)

Values of the steady-state d-c resistance of copper oxide and selenium rectifiers as a function of temperature from 79 to 300°K have been obtained. The maximum potentials used were 2.5 v in the forward direction and 6.0 v in the backward direction. It was found that a plot of the logarithm of the resistance against the reciprocal of the temperature was nearly linear for all except the reverse direction of the selenium rectifier. For the latter case at 6.0 v the resistance went through a minimum below 200°K. (auth)

6281
Los Alamos Scientific Lab.
A HYDROGEN LIQUEFIER USING NEON AS AN INTERMEDIATE; by Charles B. Hood and E. R. Grilly. [nd] Decl. Sept. 28, 1951. 13p. (AECD-3248; LADC-1049)

A hydrogen liquefier is described in which the hydrogen is condensed at 5 to 6 atm pressure by means of liquid neon produced in a Joule-Thomson liquefier. This liquefier consumed 17 liters per hour of liquid neon and produced 28 liters per hour of liquid hydrogen, representing an increase of about 20% over direct Joule-Thomson liquefaction of the hydrogen. Means are described whereby further increases in performance could be achieved. (auth)

6282
A MAGNETIC ION SOURCE OF THE HEIL TYPE. J. Kistemaker and C. J. Zilverschoon. Physica 17, No. 1, 43-9(1951) Jan.

An ion source is shown comprising a Cu cylinder set against the inner wall of the vacuum chamber and having a filament at one end and a graphite electron-reflector plate at the other. A hollow, high-tension negative electrode is set at 7 mm from an exit hole midway of the cylinder and contains a target plate about 3½ cm from its open end. Operating characteristics are discussed.

6283
DESIGN OF A CYCLOTRON MAGNET. I. POLE DESIGN USING A HALF-MAGNET. M. Foss, J. G. Fox, R. B. Sutton, and E. C. Creutz. Rev. Sci. Instruments 22, 469-72(1951) July. (See also NSA 1-1661)

In order to measure the effects of gross changes in the design of the pole and yoke for a large synchro-cyclotron cheaply and conveniently, a model half-magnet having a 2-in. diam pole was constructed. From data on the fields produced by poles of various lengths using a fixed amount of copper in the coil, the pole length for which the cost of power and magnet steel was a minimum could be determined. Measurements of the efficiencies of poles of various shapes indicated that it would be possible to design a shimmed pole to have an efficiency of 70 to 75% at a field of 20,000 gauss. Finally data on over-all magnet efficiency as a function of the ratio of the cross-sectional areas of the yoke and pole permitted calculation of the ratio for which the cost of steel, copper, and power would be a minimum. (auth)

6284
A HIGH RESOLUTION TWO-DIRECTIONAL FOCUSING BETA-RAY SPECTROMETER. A. A. Bartlett and K. T. Bainbridge. Rev. Sci. Instruments 22, 517-23(1951) July.

A large beta-ray spectrometer based on the theory worked out by Siegbahn, Svortholm, and others has been constructed. The magnet design is unique in that the return path in iron for the gap flux is provided by a circumferential yoke rather than by an axial core. The mean radius of the electron orbits is r_0 = 30 cm and the maximum acceptable solid angle with present diaphragms is 0.8% of a sphere. Construction is discussed and data are presented to show the resolution to be approximately 0.4% under these conditions. (auth)

6285
A METHOD OF CALIBRATING NEUTRON SOURCES ABSOLUTELY. D. J. Littler. Proc. Phys. Soc. (London) 64A, 638-47(1951) July.

A method has been developed for calibrating neutron sources absolutely, using the Graphite Low Energy Experimental Pile. The method used is to convert the measurement of the number of neutrons emitted by a source to a determination of the absolute beta activity of an irradiated sodium or phosphorus sample. One source calibrated by this method, which contained 1,290 mg of radium in the form of sulphate, mixed with 12 g of beryllium, was found to have a neutron strength of 9.3×10^6 n/second (±4½%). (auth)

6286
INSTRUMENTATION FOR I^{131} USE IN MEDICAL STUDIES. Benedict Cassen, Lawrence Curtis, Clifton Reed, and Raymond Libby. Nucleonics 9, No. 2, 46-50(1951) Aug.

Scintillation counters have proved useful for the detection of γ radiation from tissue. Several types of such counters have been designed previously to detect the γ rays from I^{131}. The success of one of these for delineation of thyroid glands has led to the construction of a device for automatic scanning of the gland area and recording of the result. Construction and use are described briefly. 6 figures.

6287
ON THE ERADICATION OF UNWANTED ELECTRON TRACKS IN ELECTRON-SENSITIVE NUCLEAR EMULSIONS WITHOUT LOSS OF SENSITIVITY; G. Albouy and H. Faraggi. Rev. Sci. Instruments 22, 532(1951) July. (Laboratory and shop notes)

A description is given of an improved method of eradicating the latent image by unwanted electrons in electron-sensitive nuclear emulsions, type Ilford G5 or Kodak NT4, without any loss of sensitivity. The emulsions are placed horizontally in a hermetically closed thermostat kept at 60°C in an atmosphere saturated with water vapor. After about 15 to 20 hr they are withdrawn, cooled, and dried in a weak draft for about 1 hr. They are carefully kept in horizontal position during these operations to avoid subsequent distortions. Then, they are exposed and developed by usual methods.

6288
THE CALCULATION OF THE GEOMETRICAL EFFICIENCY OF END-WINDOW GEIGER-MÜLLER TUBES. E. Berne. Rev. Sci. Inst. 22, 509-12(1951) July.

Integrals for the calculation of the solid angle of a plane disk in respect to the window of an end-window G-M tube have been derived. Numerical values for a window diameter of 30 mm have been computed.

ISOTOPES

6289
Melbourne Univ. (Australia)
PROCEEDINGS OF CONFERENCE ON APPLICATIONS OF ISOTOPES IN SCIENTIFIC RESEARCH; AUGUST 1950. July 1951. 204p. (NP-3368)

Papers with the following titles are included: Fundamentals of Nuclear Physics; Statistical Problems in Utilization of Isotopes; Techniques of Assay of Stable Isotopes; Techniques of Assay of Radioactive Isotopes; Applications of Nuclear Emulsions; Limitations of the Tracer Method in Scientific Research. I. Physical Aspects; Limitations of the Tracer Method in Scientific Research. II. Biological Aspects; Health and Safety Precautions in Handling Radioactive Materials; Use of the Heavy Oxygen Isotopes, O^{18}, as a Tracer Element. I. Reactions in Liquid Sulphur Dioxide; Use of the Heavy Oxygen Isotope, O^{18}, as a Tracer Element. II. The Interchange of Oxygen Between Water and Inorganic Oxy-compounds; Some Attempts to Concentrate the K^{40} Isotope; Exchange Reactions and Chemical Structure; Applications of Isotopic Tracers in Entomological Research; Studies of Factors Affecting the Distribution of Manganese in Plants by the Use of Radioactive Manganese, Mn^{54}; Self-Diffusion in Tin; The Use of Radioactive Tracers in the Separation of Hafnium and Zirconium; Assay of Radioactive Mineral Ores; Problems in the Synthesis of Isotopic Molecules. I. General Considerations; and Problems in the Synthesis of Isotopic Molecules. II. Heavy Hydrogen Compounds.

6290
THE ERROR DISTRIBUTION IN THE PHOTOMETRIC DETERMINATION OF ISOTOPE ABUNDANCES. Joseph Mattauch. Z. Naturforsch. 6a, 392-6(1951) July. (In German)

Data on relative isotope abundances, as obtained by a photometric method described elsewhere (Naturwissenschaften 31, 487(1943); Z. Physik 122, 314(1944)), are used for a computation of the statistical scattering of the results. The scattering error is found to be 2½ times as large as that required by the theory of random errors. This can be explained by assuming that, in every observation series, errors in only one-half of all single observations are statistically independent; so that, e.g., the errors of two successive observations are, on the average, equal. Since the main source of statistical errors in the measurement of line intensities lies in the nonhomogeneity of the photographic emulsion, the foregoing effect can be interpreted by saying that the average size of those regions in the emulsion which can be regarded as homogeneous, is such that line intensities are, on the average, equally affected in two consecutive exposures. (auth)

6291

ENRICHED STABLE ISOTOPES: FIVE YEARS OF PRODUCTION AND USE. C. P. Keim. Nucleonics 9, No. 2, 5-9 (1951) Aug.

A general review of the years from 1945 to 1951 of the stable isotope program is presented. The topics discussed are production and use of enriched stable isotopes and operation of calutrons. No new experimental data are given.

6292

K CAPTURE IN I^{128}. W. B. Mims and H. Halban. Proc. Phys. Soc. (London) 64A, 753-4(1951) Aug. (Letter to the editor)

X rays emitted by I^{128} have been observed to consist of Te K radiation. In order to estimate the proportion of I^{128} nuclei decaying by K capture, a comparison of β-ray emission and of x-ray emission was made between sources of In^{114} and I^{126}. A branching ratio, K capture to β decay, of $6.3 \pm 0.7 \times 10^{-2}$ was found.

MASS SPECTROGRAPHY

6293

Brookhaven National Lab.

THE MASS SYNCHROMETER (abstract); by Lincoln G. Smith. Aug. 16, 1951. 2p. (AECU-1624)

The report is reproduced here in its entirety.

Development work on a new instrument for comparing with high accuracy the cyclotron frequencies or periods of two types of ions of approximately equal mass and hence of determining their mass difference will be described. In this instrument the velocities of ions which have traveled in a uniform magnetic field 180° from a source are modulated in an electric field of small extent in space which varies in time. Short groups of ions whose momenta have been reduced the proper amount are thereby periodically selected. These ions can, in the absence of further disturbances, execute many rotations in nearly the same plane without striking the source housing. If on a subsequent passage through the velocity-modulating electrodes they again acquire the same reduction of momentum they will enter an electron multiplier and be detected. To date velocity modulation has been obtained by applying short rectangular potential pulses, and the cyclotron period has been measured from the time interval between two such pulses required to bring ions to the detector after several (up to 90) rotations. A half-width resolution for about 20 rotations (16 m) of about 14,000 has been obtained at mass number 28 with fairly good intensity. Work is now in progress to use sinusoidal velocity modulation by applying r-f to the modulating electrodes and thus to measure the cyclotron frequency as a submultiple of the r-f required for maximum signal at the detector. Here ions will be allowed to execute only one turn so that intensity and vacuum problems will be much simplified and intensity should be greatly augmented because of a very large increase in duty cycle without (it is hoped) any reduction in resolution.

6294

Brookhaven National Lab.

MASS MEASUREMENTS WITH A MAGNETIC TIME-OF-FLIGHT MASS SPECTROMETER; by E. E. Hays, P. I. Richards, and S. A. Goudsmit. [nd] 17p. (AECU-1637)

A new mass spectrometer has been used to measure the time of flight of ions for a number of complete revolutions in a uniform magnetic field. A pulsed ion source is placed about 12 cm above an ion detector in a vertical magnetic field of about 450 gauss. Some ions leave the source with a vertical velocity component, and travel in a helix, reaching the ion detector after one, two, three, or more revolutions, depending on the initial vertical velocity. About 12 revolutions can be recorded with sufficient intensity for measurement. The time of flight is independent of direction and magnitude of the initial velocity of the ions; ions with different velocities move along different paths. In addition to this time focusing, the field produces a space focusing; after each revolution the ions focus along a field line passing through the source. This spectrometer does not require narrow defining slits. However, it is actually necessary to restrict the circular path of the ions somewhat by means of baffles. The spectrometer is especially suitable for heavy masses. A few of the masses so far obtained are: S^{32}, 31.983 ± 0.001; Cl^{35}, 34.9805 ± 0.0005; Xe^{134}, 133.947 ± 0.0002. Masses are also tabulated for K^{41}, $Br^{79,81}$, Kr^{84}, $Rb^{85,87}$, I^{127}, $Xe^{129,130,131,132}$.

6295

THE MASS-DIFFERENCE $C^{12}(H^1)_4 - O^{16}$, $C^{12}(H^1)_2 - N^{14}$, AND $C^{12}(H^1)_3 - N^{15}$. K. Ogata and H. Matsuda. Phys. Rev. 83, 180-1(1951) July 1. (Letter to the editor)

By means of the recently reconstructed and improved Bainbridge-Jordan type mass spectrograph at Osaka University, measurements have been made of the mass differences of $C^{12}(H^1)_4 - O^{16}$, $C^{12}(H^1)_2 - N^{14}$, and $C^{12}(H^1)_3 - N^{15}$. The observed mass differences (in units of 10^{-4} amμ) are, respectively: 364.43 ± 0.05, 125.94 ± 0.02, and 233.95 ± 0.05. Mass differences of molecular-molecular doublets were found to be in good agreement with those of atomic-molecular doublets for both $C^{12}(H^1)_4 - O^{16}$ and $C^{12}(H^1)_2 - N^{14}$. The $N^{15} - N^{14}$ mass differences calculated from these measurements is $0.997332 \pm 0.06 \times 10^{-4}$, using the Mattauch-Flammersfeld H^1 value of $1.0081297 \pm 0.032 \times 10^{-4}$.

6296

A HEAD FOR A MASS SPECTROMETER, PERMITTING THE USE OF HIGH GAS PRESSURES IN THE IONIZATION CHAMBER. G. Philbert. J. phys. radium 12, 143-4(1951) Feb. (Letter to the editor; in French)

The bronze attachment with adjustable diaphragm is described briefly. Inserted between the analyzer and source, a pressure of 0.01 mm was maintained in the ionization chamber, while the pressure in the spectrometer was 3×10^{-5} mm.

6297

MASSES OF THE SUBSTANDARDS H^1, D^2, C^{12}, AND OF OTHER LIGHT ATOMS. Heinz Ewald. Z. Naturforsch. 6a, 293-302(1951) June. (In German)

New measurements of 18 mass-spectrographical doublets were made. The results, presented in tables, are compared with previously accepted values. They furnish new masses of n^1, H^1, D^2, He^4, C^{12}, C^{13}, N^{14}, N^{15}, O^{17}, O^{18}, F^{19}, Ne^{20}, Ne^{21}, Ne^{22}, Si^{28}, P^{31}, S^{32}, S^{34}, and A^{40}. (auth)

6298

PARENT PEAK INTENSITIES AS A BASIS FOR ESTIMATING PURITIES OF DEUTERIUM SUBSTITUTED COMPOUNDS. H. W. Rollmann and H. L. McMurry. J. Chem. Phys. 19, 804(1951) June. (Letter to the editor)

Data are presented which furnish convincing support for the assumption that parent peaks in the mass spectra of hydrocarbons differing only by deuterium substitution will be nearly the same when obtained under the same conditions as the parent peaks of the unsubstituted compounds. From comparative parent peak-intensity data the purity of several synthesized samples has been calculated.

MATHEMATICS

6299

Los Alamos Scientific Lab.

CRITERIA OF STABILITY FOR THE NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS; by Herbert A. Forrester. Aug. 22, 1951. 64p. (LA-1287)

The stability conditions, in the numerical solution of partial differential equations, under which the numerical

error is small throughout the entire region of integration are developed. Von Neumann's and Eddy's criteria for stability are presented, and numerical solutions of the heat and wave equations are discussed as examples. Methods of estimating the errors in both ordinary and partial differential equations are derived.

6300
THE INTEGRAL $\int_0^\infty y^3 \exp(-y^2 + ix/y)dy$. U. E. Kruse and N. F. Ramsey. J. Math. Phys. 30, No. 1, 40-3(1951) Apr.

The average over the neutron beam velocity distribution of a trigonometric function of the time a neutron spends in a region of space reduces to an expression of the form $\int_0^\infty y^3 \exp(-y^2 + ix/y)dy$. Conventional methods of evaluating the integral fail; so a direct tabulation has been carried out for the functions $I(x) = \int_0^\infty \exp(-y^2)y^3 \cos(x/y)\,dy$, and $K(x) = \int_0^\infty \exp(-y^2)y^3 \sin(x/y)dy$, which are related to the integral in question by $I(x) + iK(x) = \int_0^\infty y^3 \exp(-y^2 + ix/y)dy$.

6301
A NUMERICAL VARIATIONAL METHOD. R. E. Meyerott, P. J. Luke, W. W. Clendenin, and S. Geltman. Phys. Rev. 83, 846-7(1951) Aug. 15. (Letter to the editor)

A numerical variational method for the solution of eigenvalue problems is suggested. The problem was set up on the basis of the variational principle for one and two independent variables. For one variable, the interval of the independent variable is subdivided by a set of equally spaced net points. The values at these points are used as variational parameters. Elsewhere the trial function is defined by a linear interpolation formula. The Rayleigh-Ritz energy integral then leads to a set of simultaneous linear equations in the variational parameters. The coefficients involve the energy and integrals of the potential energy. The equations may then be used in the same manner as the relaxation equations. A similar procedure is used for two independent variables.

6302
A MONTE CARLO METHOD FOR SOLVING A CLASS OF INTEGRAL EQUATIONS. R. E. Cutkosky. J. Research Natl. Bur. Standards. 47, 113-15(1951) Aug.

This note describes a random walk equivalent to the Neumann series solution of an integral equation. This procedure is shown to be similar to those used to solve certain problems dealing with scattering of particles, which can be formulated in terms of a nonhomogeneous integral equation. A diffusion analogy and the problem of importance sampling are discussed briefly.

MEASURING INSTRUMENTS AND TECHNIQUES

6303
Commonwealth X-Ray and Radium Lab.(Australia)
DATA FOR ASSAY OF RADIOACTIVE MATERIALS WITH GEIGER COUNTER EQUIPMENT; TECHNICAL COMMUNICATION NO. 33; by T. H. Oddie and S. A. Mibus. July 1949. 61p. (NP-3362)

6304
Brookhaven National Lab.
INSTRUMENTATION AND HEALTH PHYSICS, p.17-25, 61-2 of QUARTERLY PROGRESS REPORT; APRIL 1–JUNE 30, 1951. Issued Aug. 1951. 11p. (BNL-117 (p.17-25, 61-2))

Responses of a logarithmic count-rate meter to β radiation and of a LiI(Tl) scintillation crystal to slow neutrons are shown graphically. Efficiencies of various counters used in area monitoring and activities found at points in the liquid-waste disposal system are tabulated. Brief statements of progress on various instrumentation problems are included. The insensitive volume of G-M tubes has been measured.

6305
Atomic Energy Project(Canada)
PROGRESS REPORT MAY 16–AUGUST 15, 1951; ELECTRONICS BRANCH; by J. Hardwick. [nd] 15p. (PR-P-11-E)

Brief statements of construction or experimental status of scintillation and millimicrosecond techniques, mass-spectrometer instrumentation, counting systems, power supplies, etc. are presented. No appreciable technical data are included.

6306
Brussels Univ.
ON PROCESSING NUCLEAR EMULSIONS; PART II AFTER DEVELOPMENT TECHNIQUES; by A. Bonetti, C. C. Dilworth, and G. P. S. Occhialini. Mar. 1951. (NP-3359)

Sources of distortion encountered in processing thick nuclear emulsion plates after exposure and precautions to prevent distortion are discussed. This is a sequel to Part I, abstracted as NSA 5-1315.

6307
Carbide and Carbon Chemicals Co., K-25
PROPORTIONAL FISSION NEUTRON COUNTERS; by R. C. Rohr, E. R. Rohrer, and R. L. Macklin. Mar. 26, 1951. Decl. Sept. 20, 1951. 8p. (AECD-3246)

Some proportional fission neutron counters with inner coatings of U oxide or tetrafluoride are described, with information on methods of preparation and details of a circuit for a portable model. The portable instrument has an efficiency of 0.01% for neutrons from Po-Be sources. (auth)

6308
Argonne National Lab.
A-C OPERATION OF IONIZATION CHAMBERS; by R. M. Kiehn. Aug. 1951. 19p. (AECU-1630)

A parallel-plate ionization chamber was used as a "leaky" capacitor in one arm of an a-c capacitance bridge excited at audio frequencies. Response of the instrument to a Ra-Be source was measured as a function of the a-c plate voltage across the chamber, chamber plate spacing, and frequency of the excitation voltage. Signal-to-noise ratios of 40/1 and greater were obtained at a d-c level of 10^{-11} amp. Hence, the sensitivity of the instrument is 2.5×10^{-13} amp, and is limited, in a practical design, by the residual bridge unbalance. Response times of 150 msec were obtained using an air chamber with 1/8-in. plate spacing. As the highest resistance in the circuit is 10^8 ohms, insulation problems in construction of ion chambers are greatly reduced. No preamplifier is necessary, and since the resistance and capacity of the bridge-to-chamber leads are compensated in the bridge circuit, long leads may be used between the bridge and the chamber. 10 figures. (auth)

6309
Atomic Energy Project, Univ. of Rochester
A CHEMICAL DOSIMETER FOR IONIZING RADIATIONS; by John W. Kanwisher. Aug. 29, 1951. 62p. (UR-167)

A method for measuring dosage of penetrating ionizing radiation has been developed based on measurement of the increase in conductivity in the water layer of a chloroform-water system sealed in a fountain pen–sized, light-opaque, pyrex glass–lined capsule. The increased conductivity is due to small amounts of HCl formed by the radiation which diffuse into the water layer on shaking. The conductivity is measured by determining the absorption of energy from a radio frequency field by the water phase. The present dosimeter, which is intended for casualty use, has a full scale range of 600 r. A full scale range of 100 r is entirely possible, or in the other direction the dosimeter can be made as insensitive as desired.

6310
Los Alamos Scientific Lab.
ENERGY RESPONSE OF NaI (Tl) CRYSTALS TO ALPHA PARTICLES OF LESS THAN 10 MEV; by Ralph H. Lovberg. [nd] 4p. (AECU-1638; LADC-1046)

The response of NaI crystals to α particles of <10 Mev has been investigated. Two thin sources were used, one yielding α groups at 8.78 and 6.04 Mev from ThC' (Po^{212}) and ThC(Bi^{212}), respectively, and the other giving 5.16-Mev α particles from Pu^{239}. Energy control was accomplished by air attenuation. Mean particle energies were computed from Bethe's range-energy curves. The entire operation was performed in a dry-box, with signal and high-voltage cables brought in to the 5819 photomultiplier by means of airtight feed-through connectors. Output of the 5819 was fed into a low-gain preamplifier for polarity inversion, through a Los Alamos model 503 pulse amplifier, and into a continuously variable single-channel pulse-height discriminator. Mean output pulse height for each source-probe position is plotted against computed mean energy. Abstracter's note: The curve appears to be nearly linear above ~6 Mev, and slightly concave upward from 1 to 6 Mev.

6311
STABILITY FACTORS OF END-WINDOW GEIGER-MUELLER COUNTERS (BELL-JAR ARGON-ALCOHOL COUNTERS). André Papineau. J. phys. radium 12, 667-70(1951) June. (In French)

The influence of the diameter and nature of the terminal bead on the central wire, distance of the bead from the window, and proportion of alcohol in the gas on the behavior of mica end-window G-M counters has been studied. A very stable and reproducible counter is illustrated.

6312
A SCINTILLATION COUNTER FOR CLINICAL USE. Douglas Kohl, George Moore, and Shelley Chou. Nucleonics 9, No. 1, 68-73(1951) July.

A scintillation counter designed for brain-tumor localization is described. The field-sensitivity pattern of the counter approximates the optimum pattern established from clinical data. An important feature of the pattern is that a considerable portion of each isosensitivity curve is perpendicular to the cylindrical axis of the detector, in effect defining a circular equisensitive surface. An 18% counting efficiency for I^{131} γ rays can be attained with a background of only 200 cpm, giving an increase in efficiency of 9 times that of the special-purpose G-M tubes and 33 times that of conventional mica-window G-M tubes. An accuracy of 100% was achieved in locating tumors in 16 clinical cases.

6313
A COMPARISON OF THE EXPERIMENTAL AND COMPUTED FAST NEUTRON EFFICIENCIES OF A SCINTILLATION COUNTER. George E. Owen, John Neiler, and William Ray. Phys. Rev. 83, 675-6(1951) Aug. 1. (Letter to the editor)

The calculated counting rate for a 1-in. cube of anthracene is compared with the experimental counting rate. A standard Po-Be source with a continuous energy distribution from 0 to 11 Mev was used, and a Pb absorption curve was run at each discriminator setting. The correlation between experiment and theory suggests that fast-neutron intensities can be measured quite accurately by the method described, but that all fast-neutron counting performed with scintillation counters must be subjected to the discriminator correction factor which is derived theoretically in the paper.

6314
ON A DIRECTIONAL EFFECT OF GEIGER-MUELLER COUNTERS. Anatole Rogozinski. Compt. rend. 233, 426-8(1951) July 30. (In French)

A series of tests of Geiger counters, using cosmic radiations, showed that the steepness of rise of a pulse depends on the angle between the particle's path and the counter's axis; the rise is steeper for smaller angles. A circuit selecting only very steeply rising pulses will record only particles whose paths are nearly parallel to the counter's axis. (auth)

6315
THE DESIGN OF THIN-WINDOWED GEIGER-MÜLLER COUNTERS. R. L. Purbrick, Lawrence T. Cherry, and James F. Carpenter. Rev. Sci. Instruments 22, 482-4(1951) July.

A thin-windowed G-M counter whose effective counting length can be varied by means of a movable glass sleeve surrounding the central wire was used to find the optimum length of an end-window counter for the measurement of weak C^{14} activities. The optimum length was found to be about 1 cm.

6316
HOUSEHOLD FOIL SHIELDS COUNTER CABLES. Allen McDonald. Nucleonics 8, No. 6, 41(1951) June. (Cross sections)

Spurious counts in a proportional counting arrangement caused by the electromagnetic field of an induction heater on the floor above were eliminated by wrapping the cable connecting counter and scaler with household Al foil.

6317
DISCUSSION OF A MEASUREMENT OF THE MULTIPLE COULOMB SCATTERING. Claude Mabboux. Compt. rend. 232, 2309-11(1951) June 18. (In French)

The causes of errors in measurements of the tracks of high-energy (cosmic-ray) particles in photographic emulsion are discussed, and the experimental conditions necessary to obtain the best estimation of the scattering constant are considered.

6318
SOME ASPECTS OF THE COUNTING PROPERTIES OF DIAMOND. G. P. Freeman and H. A. van der Velden. Physica 17, 565-72(1951) June.

Hecht's function, which gives a relation between the magnitude of the signal and the field strength in the crystal and determines a minimum value for the product of electron mobility and mean free time, has been determined for a diamond specimen irradiated with Po α particles. The dimensions of the hypothetical counting cells are estimated. The energy necessary for the liberation of one electron in a diamond crystal appears to be 8.6 ev or less. Evidence is given that the parts of a mixed crystal used for the counting of α particles are of type II (transparent to ultraviolet light).

6319
THE RANGE OF PROTONS FROM THE REACTION $^{14}N(n,p)^{14}C$ IN ILFORD C2 PHOTOGRAPHIC EMULSION. F. A. El-Bedewi. Proc. Phys. Soc. (London) 64A, 584-5(1951) June. (Letter to the editor)

An accurate determination is given of a point on the range-energy curve for low-energy protons in Ilford C2 photographic emulsion. For this purpose the reaction $N^{14}(n,p)C^{14}$ induced by the action of thermal neutrons on N present in the emulsion was employed. The observed mean range was 6.55 ± 0.01 μ. Taking the range of the proton as 0.995 ± 0.01 cm of air and assuming that the stopping power in the emulsion for the C^{14} recoil is the same as that for these protons, the range of the recoil nucleus in the emulsion was estimated to be 0.19 μ. Thus the range of the proton of energy 0.584 ± 0.003 Mev can be stated as 6.36 ± 0.05 μ.

6320
EXPERIMENTS WITH SCINTILLATION COUNTERS. W. Hanle and H. Schneider. Z. Naturforsch. 6a, 290-3(1951) June. (In German)

The optimal frequency range of amplifiers for scintillation counters is discussed. Measurements of the luminescence produced by impinging particles in solid and liquid organic compounds are reported. (auth)

6321
ABSORPTION SPECTRUM OF THALLIUM-ACTIVATED POTASSIUM CHLORIDE PHOSPHOR AT LOW TEMPERATURES. Peter D. Johnson and F. J. Studer. Phys. Rev. 82, 976(1951) June 15. (Letter to the editor)

An important feature of recent quantitative theoretical work on solid-state luminescence is the effect of zero-point energy in maintaining broad absorption and emission spectra at low temperatures. A description is given of experiments which were performed to study the optical absorption of KCl:Tl in the band near 5 ev due to Tl^+. The values of experimental half-widths can be reconciled only with the values calculated using zero-point energy, and the zero-point energy used in the calculations must be of the correct order of magnitude. The experimental variation with temperature in peak height of absorption agrees well with the calculated absorption.

6322
THE BACKGROUND COUNTING RATE IN A GEIGER-MÜLLER COUNTER. D. H. Pierson. Proc. Phys. Soc. (London) 64B, 427-8(1951) May. (Letter to the editor)

During a radioactivity survey of S. W. England and N. Wales during the summer of 1950, the counting rate due to gamma-ray background was measured in various localities and related to radiometric assays of soil activity. The apparatus used consisted of a probe unit containing 3 Geiger counters Type CV2148, enclosed in a cylindrical dural case of wall thickness 1.25 mm, and this was coupled to a cold cathode valve ratemeter circuit registering on a 0 to 50 microammeter. The Geiger counters were connected individually so that simultaneous pulses were not lost in coincidence. Specific counting rates and radiometric assays of 5 samples are tabulated. That contamination and atmospheric activity due to emanations diffusing from the surface contribute negligibly to the ratemeter reading at zero soil activity was indicated.

6323
RADIOACTIVITY MEASUREMENTS WITH THE AID OF NONCRYSTALLINE FLUORESCENT SOLIDS. L. Pichat and Y. Koechlin. J. chim. phys. 48, 225-8(1951) May-June. (In French)

A 2% solid solution of 1,1,4,4-tetraphenyl-1,3-butadiene (TPB) in polystyrene used in a scintillation counter shows a better performance than do solid solutions of p-terphenyl, anthracene, and stilbene, which have been recommended by several authors; it is also superior to the saturated solution of TPB in xylene, but is about equivalent to the solution of terphenyl in xylene. In the concentration range between 0.1% and the pure TPB crystal, the mean scintillation intensity increases linearly with the logarithm of the concentration, the slope of the lines being very close to ⅔. (auth)

6324
COLORIMETRIC METHOD FOR DOSIMETRY OF 10-100 r. G. V. Taplin, C. H. Douglas, and B. Sanchez. Nucleonics 9, No. 2, 73-7(1951) Aug.

The two-phase chloroform–dye indicator system of radiation measurement was modified to provide a suitable method for indicating γ-ray doses of 10 to 100 r. The increase in sensitivity was accomplished by removal or reduction of the alcohol content of the chloroform.

6325
A COMPREHENSIVE COUNTING SYSTEM FOR NUCLEAR PHYSICS RESEARCH. PART IV. INTRODUCTION TO PULSE AMPLITUDE ANALYZERS. N. F. Moody, W. J. Battell, W. D. Howell, and R. H. Taplin. Rev. Sci. Instruments, 22, 551-4(1951) Aug.

An outline is given of pulse amplitude analyzing equipment as applicable in nuclear studies. Indications are that for pulse widths of 1 μsec and larger, the thermionic diode leaves little to be desired as a voltage discriminating element.

6326
SCINTILLATION DETECTOR FOR THE LOCALIZATION OF RADIOACTIVE CONCENTRATIONS IN VIVO. William B. Ittner III, and M. Ter-Pogossian. Rev. Sci. Instruments 22, 638-41(1951) Aug.

A radiation detection instrument, employing a large naphthalene-anthracene crystal and a concentric conical collimator, for the determination of the in vivo distribution of therapeutic doses of radioisotopes is described. A simplified method of obtaining the general outline of volumetric distributions of radioiodine is presented.

6327
RADIATION AND PARTICLE DETECTORS IN MODERN NUCLEONIC INSTRUMENTS. Denis Taylor. J. Brit. Inst. Radio Engrs. 11, 247-59(1951) July.

The paper gives a brief review of the radiation and particle detectors used in modern nucleonic instruments and classifies the measuring systems used under four headings: (i) integrating systems; (ii) systems in which the mean current through the detector is measured, e.g., systems using current chambers, multiplying current chambers, etc.; (iii) counting systems; and (iv) counting systems using an averaging circuit in the indicating unit, e.g., counting-rate meters. The paper includes a discussion of the long-term stability of the radiation and particle detectors used in assay and other instruments and discusses the relative advantages and disadvantages of Geiger-Mueller counters, proportional counters, and scintillation counters from this point of view. Special consideration is given to the problem of industrial instrumentation where high reliability is the first consideration. The paper concludes with a description of a typical process control instrument developed at the Atomic Energy Research Establishment for the continuous monitoring of α activities in solution, and attention is directed to the precision of measurement possible under routine conditions. (auth)

6328
INVESTIGATION ON MAGNETIC SPECTROGRAPHY OF ALPHA PARTICLES EMITTED BY RADIOACTIVE SUBSTANCES. Eugène Cotton. Ann. phys. (12) 6, 481-560 (1951) May-June. (In French)

Certain optimal conditions of work with magnetic α spectrographs were determined, and nuclear photoemulsions used in such work were calibrated on the basis of range-energy relations in these emulsions. These preliminary results were applied to fine-structure measurements of the α radiation of Pa. Six groups of α energies were recognized: 5042, 5002, 4938, 4838, 4720, and 4620 kev. The 5042 ± 7 kev group corresponds to a disintegration energy 5131 kev. Using Gamow's formula, a spin of 9/2 is assigned to Ac^{227}.

6329
THEORETICAL EFFICIENCY OF X-RAY COUNTERS. Gilbert Barrère. J. phys. radium 12, 107-11(1951) Feb. (In French)

The theoretical efficiency of x-ray ionization counters has been studied as a function of dimensions and coefficient

of absorption of the filling gas. Results of an experimental study of the theory are given.

6330

CALCULATION OF THE ERROR OF IONIZATION MEASUREMENTS IN A CHAMBER WITHOUT GUARD ELECTRODES. H. Tellez-Plasencia. J. phys. radium 12, 89-92(1951) Feb. (In French)

In an ionization chamber without guard electrodes the field is not uniform, and the ionization volume, saturation conditions, and utilization energy are imperfectly defined. Equations for making corrections for these effects are derived.

6331

REBUILDING BORON-WALL NEUTRON COUNTERS. E. H. Daggett. Nucleonics 9, No. 2, 72-3(1951) Aug.

Failure of B-wall tubes can be attributed to the following: a broken center wire or its end insulator, a leak that has allowed air to enter the tube, or (a remote possibility) depletion of the ethyl ether by a very large number of counts. The most satisfactory repair is to rebuild the tube completely. The procedure is described.

6332

OSCILLOGRAPHIC RECORDING OF PULSE COINCIDENCES. V. V. Vladimirskiĭ and Yu. V. Trebukhovskiĭ. Zhur. Eksptl'. i Teoret. Fiz. 21, 663-4(1951) May. (Letter to the editor; in Russian)

Coincidence pulses obtained in various combinations of self-quenching counters can be recorded on a cathode oscillograph. Pulses which arrive in the circuit simultaneously are recorded in succession, being separated by definite time intervals which are determined by the retarding circuits connected with each counter. The resulting oscillographic picture of a coincidence is a row of pulses whose position indicates the individual counters involved.

6333

SPECTROMETRY OF β AND γ RAYS OF ARTIFICIAL RADIOACTIVE SUBSTANCES. Nadine Marty. J. phys. radium 12, 621-30(1951) May. (Review; in French)

After discussing the principal types of β-ray spectrometers, counters, and sources, the author describes the determination of simple spectra, energies, and intensities of γ rays and conversion electrons, and energy levels. 74 references.

6334

MEASUREMENT OF SPECIFIC DISINTEGRATION RATES BY INTERNAL GAS COUNTING. Maxwell Leigh Eidinoff. Anal. Chem. 23, 632-5(1951) Apr.

The method of counting solid samples containing radiocarbon used in this study eliminates the important difficulties of the solid-counting procedures. The use of a glass shield, the position of which can be varied along the central anode wire, eliminates counting corrections at the counter ends. The specific disintegration rate can be determined by plotting observed counting rate as a function of the position of the movable shield and by taking into account the cross-sectional area and the pressure and temperature of the gas. The efficiency in the Geiger region of the counting gas mixture containing CO_2 admixed with CS_2 was studied. The results lead to the conclusion that the efficiency of a CO_2-CS_2 mixture for β particles from C^{14} is close to 100% and that the effective counting cross-sectional area is equal to the area defined by the cathode cylinder.

6335

USE OF TRAJECTORIES ASYMPTOTIC TO STATIONARY ORBITS TO SEPARATE MONOKINETIC HIGH-MOMENTUM PARTICLE GROUPS. J. Thibaud and J. Lafoucrière. J. phys. radium 12, 642-51(1951) June. (In French)

A method of separating different electron trajectories in a trochoidal magnetic β-ray spectrograph is described, and its theory is developed in detail. Certain trajectories asymptotic to stationary orbits give a meridian curve resulting in an arrowhead-shaped trace. Application to the study of the anomalous high-momentum particles in the β decay of RaC (Bi^{214}) and P^{32} is illustrated.

6336

ON A PRECISE FOCUSING OF RECOIL ELECTRONS. B. S. Dzhelepov. Doklady Akad. Nauk S.S.S.R. 77, 389-90 (1951). (In Russian)

It has been reported in a former note (Doklady Akad. Nauk S.S.S.R. 62, 615(1948)) that Compton electrons projected by a parallel beam of γ rays from a thin celluloid film can be used for measuring γ spectra. However, the spectral lines obtained are wide because the focusing of Compton electrons by a homogeneous magnetic field is not sharp. It is shown here geometrically that, by using a diverging γ-ray beam and a curved film, accurate focusing can be obtained.

6337

EFFICIENCY CRITERIA IN RADIOACTIVITY COUNTING. Robert Loevinger and Mones Berman. Nucleonics 9, No. 1, 26-39(1951) July.

A method is presented for determining the number of sample and background counts necessary to reach a desired per cent error in minimum time. From the point of view of minimizing the counting time, a counter can be characterized by a measure of merit consisting of the sensitivity, e, and a function of the sensitivity and the counter background, e^2/R_b. In comparing two counters, the one with higher sensitivity and larger e^2/R_b is always better. If the counter with higher sensitivity has a lower I^2/R_b, the relative efficiency depends on the sample strength. For minimum combined counting time, the ratio of total to background counts is a function of r only where r is the ratio of total to background counts. Corresponding to an estimate of the total to background ratio, r, and an adopted per cent error, a graph gives the number of total and background counts for minimum combined counting time. The efficiencies of other counting procedures—equal standard deviations of total and background counts, fixed count ratio, fixed time ratio, background-known approximation, and high-level approximation—are compared to the minimum combined time method.

6338

BETA AND GAMMA RADIATION. PART III. EXPERIMENTAL METHODS OF MEASURING BETA- AND GAMMA-RAY ENERGIES. J. V. Jelley, Ph.D. Atomics (London) 2, 191-9, 210(1951) July.

A survey is made of the experimental methods (absorption, spectrometer, and ionization) used to determine energies of β and γ rays. The essential features of the measuring instruments are described in a general and nontechnical way. (See also NSA 5-725 and 5-11130)

6339

A HIGH PRECISION PULSE HEIGHT ANALYSER OF MODERATELY HIGH SPEED. G. W. Hutchinson and G. G. Scarrott. Phil. Mag. 42, 792-806(1951) July.

A pulse-height analyzer is described suited particularly to the requirements of nuclear physics. Information is stored in a supersonic delay line and displayed on a cathode-ray tube. The accuracy of channel width and the linearity of response are both one part in a thousand. The number of channels and storage capacity per channel may be varied at will to give 60 channels of up to 10^6 pulses, 80 channels of up to 3×10^4 pulses, or 120 channels of up

to 1023 pulses. The maximum counting rate is 1600/sec. The appendix of this paper contains diagrams of the latest model of the analyzer, but the script refers erroneously to the first model. The correct script is printed in an erratum in Phil. Mag. 42, 957(1951) Aug.

6340

A COMPREHENSIVE COUNTING SYSTEM FOR NUCLEAR PHYSICS RESEARCH. N. F. Moody, W. D. Howell, W. J. Battell, and R. H. Taplin. Rev. Sci. Instruments 22, 439-61(1951) July.

A majority of nuclear measurements involves digital pulse counting so that the associated instruments have many common functions. Further investigation reveals that these counting systems fall into two broad classes: those in which all pulses exceeding a certain threshold are summed, and a more complex analyzing procedure wherein pulses must be classified according to amplitude or temporal distribution. In the former class are found the orthodox scalers, while the latter defines the pulse amplitude analyzers and other machines capable of yielding spectral distributions. It is found that such instruments may be synthesized from a common group of sub units, and these are outlined and listed on a functional basis. The paper shows the manner in which the simpler instruments can be synthesized according to the proposed scheme and outlines the more complex automatic counting and analyzing systems to follow in later parts of the paper. In particular the construction of a range of scalers is illustrated and their performance specifications and photographs are shown. (auth)

6341

A MULTIPLE-ANODE ANTICOINCIDENCE RING COUNTER. C. H. Raeth, B. J. Sevold, and C. N. Pederson. Rev. Sci. Instruments 22, 461-63(1951) July.

An annular G-M counter with six anodes has been built as a replacement for the usual six-tube charged particle shielding ring in a cosmic-ray anticoincidence bundle. Experiments show that the multiple-anode counter has uniform pulse heights and starting voltages on all anodes, and a slightly higher shielding efficiency than the six-tube ring. (auth)

6342

A NEW METHOD FOR PRECISION MEASUREMENT OF THE HALL AND MAGNETO-RESISTIVE COEFFICIENTS. J. J. Donoghue and W. P. Eatherly. Rev. Sci. Instruments 22, 513-16(1951) July.

A circuit capable of measuring alternating current potentials up to 100 μv with a precision of 0.01 μv has been devised and applied to the measurement of the galvanomagnetic coefficients of semi-conductors and metals. The circuit consists essentially of a peaked amplifier applied to the out-of-balance signal between an alternating current potentiometer and the potential being measured. The galvanomagnetic coefficients are so related to the potentials that the entire measurement becomes independent of the current. As an example of the results obtainable, data are given to show the variations of the Hall and magneto-resistivity coefficients during the high temperature graphitization of index rod. The precision of the final data is of the order of 0.25%. (auth)

6343

OBSERVATIONS ON THE MULTIPLE SCATTERING OF IONIZING PARTICLES IN PHOTOGRAPHIC EMULSIONS. PART III. STATISTICS OF THE SAMPLING DISTRIBUTIONS OF SECOND DIFFERENCES AND THE TECHNIQUE OF OVERLAPPING CELLS. C. O'Ceallaigh and O. Rochat. Phil. Mag. (7) 42, 1040-9(1951) Sept.

Predictions based on a theoretical treatment (Molière 1951) of the problem of overlapping cells are in satisfactory agreement with the results of experiment. They would indicate that the dispersions of the sampling distributions of certain statistics commonly used to estimate the scattering of particles, are almost independent of λ, the coefficient of overlap. The dispersions are found to differ but little from those of measurements based on a smaller number of non-overlapping cells which are shown to be independent in the sense of ordinary statistical theory of small samples. It is concluded that the advantage of employing the technique of overlap is inappreciable. (auth)

6344

DETECTION OF RARE α DECAYS WITH THE AID OF THE PHOTOGRAPHIC PLATE. Engelbert Broda and Kurt Jenkner. Experientia 7, 121-7(1951) Apr. 15. (In German)

Faint α activities of medium-heavy elements (besides the known one of Sm) were sought with the aid of photoemulsions. For reasonable half lives, Gamow's formula gives such small energies that, although detectable by the emulsion, they would be readily distinguished from the known α emitters. Emulsions rich in AgBr were impregnated with solutions of substances tested containing Tl, Zn, Rb, Sr, Zr, Mo, Cd, Cs, Pr, Nd, Pb, and Bi. Although no new activities were found, the tests permitted the establishment of lower limits to half lives of the foregoing elements for the α decay; they exceed the half life of Th by about six orders of magnitude. Sm does not emit a second group of rays, and no α-active isotope of element 61 exists in nature in appreciable quantities.

6345

A DEVICE FOR AUTOMATIC RECORDING OF COUNTER CHARACTERISTICS. K. H. Lauterjung and L. Niklas. Z. Naturforsch. 6a, 333-4(1951) June. (Note: in German)

A circuit is described permitting rapid automatic construction of curves that represent the performance of a Geiger counter as a function of the working potential difference. The range between 800 and 1100 v, comprising the entire plateau section of the curve, was covered by the recording device in 10 sec.

6346

EFFECTS OF SOLUTION COMPOSITION IN A G-M COUNTER FOR LIQUID SAMPLES. G. Rose and E. W. Emery. Nucleonics 9, No. 1, 5-12(1951) July.

The effects of solution composition on the performance of the Twentieth Century Electronics type-M6 counter were investigated. The isotopes used were P^{32}, Na^{24}, I^{131}, Br^{82}, and Co^{60}, and the solutions were H_3PO_4, $AgNO_3$, NaI, NaOH, CCl_4, and trichloracetic acid. If the logarithm of the sensitivity to β rays is plotted against mass or electron density, a straight line is obtained, the slope of which is influenced relatively little by the energy of the particles. The presence of γ rays, in addition to β particles, causes some difference in the absorption observed with different counters and also introduces a degree of curvature into the graph. Counters with thicker walls may be expected to show greater changes in sensitivity to γ rays due to density of the medium. The most rapid variation of sensitivity with increasing density is that deduced for I^{131} after allowing for γ rays; the counting rate falls by 1% as the specific gravity rises to 1.013. No correction need be applied provided that the percentage variation in density of the solution does not exceed the percentage error that can be tolerated in the results.

6347

ON THE HERSCHEL AND CLAYDEN EFFECTS IN NUCLEAR PHOTOEMULSIONS. E. Schopper, S. Magun, and W. Braun. Z. Naturforsch 6a, 338-43(1951) July. (In German)

In various nuclear emulsions the Herschel effect in the latent image of particle tracks is additive; it is smaller in tracks of feebly-ionizing particles and, as in the case of light quanta, it fades away with time. Latent light images in nuclear emulsions also show an additive Herschel effect, as

well as an additive Clayden effect; however, upon intensive after-exposure both effects become subtractive. These properties characterize nuclear emulsions in contradistinction to "optical" emulsions. They point to a special crystal structure of the sensitive grain in the nuclear emulsion as compared to the optical one, besides differences in the grain/gelatine proportion and the grain dimensions. (auth)

6348

SLOW-NEUTRON DETECTION BY FOILS–II. C. W. Tittle. Nucleonics 9, No. 1, 60-7(1951) July.

Accurate determination of slow neutron densities by the activation method discussed in Part I (Nucleonics 8, No. 6, 5(1951) June) requires that the experimental data be corrected for absorption of resonance neutrons by the Cd cover and depression of the thermal-neutron flux by the detecting foil. A method is described whereby the first correction may be obtained for various In foil thicknesses up to 100 mg/cm^2 and for Cd thicknesses ranging from 0.02 to 0.06 in. It has not previously been pointed out in the literature that the correction is a function of the detector-foil thickness. Bothe's formulas (Z. Physik 120, 437(1943)) are reliable if transport mean free path in the medium is used where Bothe used scattering mean free path and if his sphere formulas are applied without modification to a circular disk.

6349

SCINTILLATION-COUNTER BRAIN NEEDLE. Charles V. Robinson, Bertram Selverstone, and Douglas Kohl. Nucleonics 9, No. 1, 88, 90, 92(1951) July. (Letter to the editor)

Certain conclusions reached in an article with this title (Kohl, Nucleonics 9, 79-83(1951) Mar.; NSA 5-2108) with respect to efficiency, cumbersomeness, background, and reliability are criticized and corrected.

6350

ON THE SENSITIVITY OF PHOTOGRAPHIC GRAINS TO ELECTRONS. David Okrent and A. K. Solomon. Phys. Rev. 83, 826-7(1951) Aug. 15.

Three single-grain-layer photographic emulsions have been exposed to a measured quantity of monoenergetic electrons, varying in energy from 7 to 112 kev. Two of the coatings (both chlorobromides) had high background fog, which introduced considerable error in the counting procedure. Also, neither of these films was especially sensitive to electrons. Nevertheless, it could be ascertained that the sensitivity of these coatings was fairly constant up to 50 to 70 kev, after which it dropped off slowly. These two coatings were prepared in almost identical fashion and showed a similar response to white light, yet their sensitivity to electrons differed by a factor of 8 or 9.

The third coating was a fine-grained bromoiodide, similar to the emulsions used in nuclear track plates. This coating was essentially fog-free, and reproducible results were obtained. The sensitivity was highest at low electron energies (approaching unity), dropping rapidly at first, then leveling off for higher energies. The curve of developability probability as a function of electron energy bears a close resemblance to the curve of space rate of energy loss for the electron. (auth)

MESONS

6351

Radiation Lab., Univ. of Calif.

π-MESON PRODUCTION BY PROTONS ON NUCLEI; by Ernest M. Henley. Sept. 11, 1951. 58p. (UCRL-1467)

The meson-production cross section for protons incident on nuclei is formulated in terms of two-particle transition rates and the struck-nucleon momentum distribution in the nucleus. Three different momentum densities are assumed. They are a modified Chew-Goldberger, a Gaussian, and a Fermi distribution. With these an attempt is made to fit the experimental π^+ and π^- meson spectra obtained by bombarding C^{12} with 345-Mev protons. The effect of the exclusion principle is estimated on the basis of a single-particle model for the nucleus. Meson reabsorption and scattering after production are also taken into account, but only roughly. The calculations show that the Gaussian distribution approximates nuclear conditions best, and that the fundamental proton-neutron and proton-proton production transition matrices are most probably not equal. (auth)

6352

Brookhaven National Lab.

A PHENOMENOLOGICAL TREATMENT OF PHOTO-MESON PRODUCTION FROM DEUTERONS; by C. F. Chew and H. W. Lewis. July 24, 1951. 31p. (AECU-1634)

The photo production of mesons in deuterium has been discussed phenomenologically on the basis of the following assumptions: (1) The production "matrix" is the sum of the free neutron and proton production matrices, evaluated between initial and final nuclear states. (2) The matrix elements, except for the momentum conservation factor, do not vary appreciably from their value in free nucleon photoproduction. It has been shown that the result for charged mesons is then expressible in terms of the free nucleon spin flip and nonspin flip meson production cross sections and certain overlap integrals which have nothing to do with meson theory. These integrals can be evaluated if the deuteron bound-state wave function and the di-neutron continuum wave functions are given.

6353

Radiation Lab., Univ. of Calif.

π^+-MESON PRODUCTION CROSS-SECTION AS A FUNCTION OF ATOMIC NUMBER; by D. Hamlin, M. Jakobson, J. Merritt, and A. Schulz. Aug. 29, 1951. 7p. (UCRL-1433)

The relative cross sections for the production of 53 4-Mev mesons at $0° \pm 7°$ by 340-Mev protons have been measured for C, Al, Fe, Cu, Ag, and Pb. The mesons were detected by trans-stilbene crystals. The electronic circuit was designed so that a coincidence of the pulses caused by a π^+ meson passing through one crystal and stopping in a second generated a delayed gate which was put in coincidence with the μ^+ pulse resulting from the decay of the stopped π^+ meson. Results are in qualitative agreement with the differential production cross sections for 20-Mev mesons at $150° \pm 15°$ made by 240-Mev protons (Clark, Phys. Rev. 81, 313(1951). The effective cross section per nucleon (σ/A) is a decreasing function of A similar to that measured by Mozeley for production of π^+ mesons by protons (Phys. Rev. 80, 493(1950)). In order to compare counter detection of π^+ with plate techniques, the peak spectrum for the reaction $P + p \rightarrow D + \pi^+$ was investigated. A 2-in. polyethylene target was used. The peak obtained by counters is considerably broader than that obtained by plates because of the greater energy width of the crystal detectors.

6354

ON THE LIFETIME OF THE NEGATIVE Pi-MESON. L. M. Lederman, E. T. Booth, H. Byfield, and J. Kessler. Phys. Rev. 83, 685-6(1951) Aug. 1. (Letter to the editor)

The negative π-meson lifetime has been redetermined, using the external meson beam of the Nevis cyclotron. The decays were observed in the course of the flight of π mesons through a 16-in. magnet cloud chamber. The μ^- meson mass obtained from momentum and mass analyses of the cloud-chamber data is $209.8 \pm 1.3\ m_e$, and the lifetime is $2.92 \pm 0.32 \times 10^{-8}$ sec.

6355
CAPTURE OF μ-MESONS IN HEAVY ELEMENTS. F. B. Harrison, J. W. Keuffel, and G. T. Reynolds. Phys. Rev. 83, 680-1(1951) Aug. 1. (Letter to the editor)

Mean-life measurements of negative μ mesons in Cu and Sb have been made. Large liquid scintillation counters recorded the delayed γ rays and neutrons of a few Mev produced by meson capture in the absorber. Integral delay distributions for Cu and Sb are shown, and mean lives of 0.122 ± 0.014 and 0.050 ± 0.006 μsec, respectively, were computed. Another graph shows the capture probability vs. effective atomic number Z_{eff} as calculated by Wheeler (Revs. Modern Phys. 21, 133(1949)). Good agreement with the Z_{eff}^4 law was found.

6356
MESON SCATTERING. H. A. Bethe and R. R. Wilson. Phys. Rev. 83, 690-2(1951) Aug. 1. (Letter to the editor)

The most probable value for meson scattering by protons is calculated from the observed value of diffraction scattering from C as 1 mb, with an upper limit of 5 mb. This is in good agreement with predictions by pseudoscalar meson theory. Experimental evidence is conflicting, values varying from less than 6 to 17 ± 5 mb. If the larger values are correct, the scattered amplitude must have the opposite sign for scattering from neutrons and from protons. Scalar or pseudovector mesons would behave in this way, but not pseudoscalar mesons.

6357
ON STUECKELBERG'S TREATMENT OF THE VECTOR MESON FIELD. Suraj N. Gupta. Proc. Phys. Soc. (London) 64A, 695-9(1951) Aug.

Stueckelberg's (Helv. Phys. Acta 11, 225, 299(1938)) treatment of the vector meson field has been investigated, and was found to involve difficulties similar to those of Fermi's treatment of the radiation field. It is shown that these difficulties may be removed by a procedure which involves the use of an indefinite metric and a modification of the supplementary condition. The same treatment is followed as was applied to the radiation filed in an earlier paper (Gupta, Proc. Phys. Soc. (London) 63A, 681(1950)). Only the neutral meson field is considered although the charged field may be treated in a similar way.

6358
EXPERIMENTAL DETERMINATION OF THE ELECTRON ENERGY SPECTRUM OF μ-MESON DISINTEGRATION. André Lagarrique and Charles Peyrou. Compt. rend. 233, 478-80(1951) Aug. 6. (In French)

Cloud-chamber measurements of the energies of 150 electrons and positrons from μ-meson decay have been fitted statistically to the two-parameter theoretical equation of Michel (Proc. Phys. Soc. (London) 63, 514(1950)) for decay into one electron and two neutrinos. The energy spectra of electrons and positrons are given separately, and the possibility of a difference between them is discussed.

6359
THE SPIN OF THE PION VIA THE REACTION $\pi^+ + d \rightleftharpoons p + p$. R. Durbin, H. Loar, and J. Steinberger. Phys. Rev. 83, 646-8(1951) Aug. 1.

It is possible to determine the spin of the pion by comparing the forward and backward rates of the reaction $\pi^+ + d \rightleftharpoons p + p$. The backward rate has been measured at Berkeley. The forward rate has been measured by the authors at Columbia University. Comparison of the two results shows the spin to be zero. In the light of other recent experimental results the meson is then pseudoscalar. (auth)

6360
ON AN ALTERNATIVE DECAY PROCESS FOR THE NEUTRAL π-MESON. R. H. Dalitz. Proc. Phys. Soc. (London) 64A, 667-9(1951) July. (Letter to the editor)

A decay process for the π^0 meson which involves a direct pair creation is suggested as an alternative to the two-photon process. Its importance arises from the fact that the pair is created at the point of decay of the meson and will therefore be found close to the "star." In this process, the meson is transformed first into a real and a virtual photon, the latter then directly producing an electron pair. On the average, 1 in 80 π^0 mesons will decay in this manner.

6361
ELECTROMAGNETIC INTERACTIONS OF μ-MESONS. W. D. Walker, J. E. Hammel, R. M. Sinclair, and J. D. Sorrel. Phys. Rev. 83, 655-6(1951) Aug. 1. (Letter to the editor)

Because of the finite size of the particles, a deviation from the calculated energy spectrum of electrons knocked on by μ mesons should occur for collisions with high momentum transfer. A preliminary experiment has been done in an attempt to determine at what electron energy this deviation occurs in order to estimate the size of the charge distributions of the colliding particles. The collisions were observed in a cloud chamber with carbon plates. Agreement between theory and experiment is good up to momentum transfer of at least 25 Mev/c (5 Mev/c in the center-of-mass system). Thus it appears that the inverse square law holds down to distances of $\hbar/\Delta p = 4 \times 10^{-13}$ cm.

6362
A PHOTOGRAPHIC STUDY OF THE $\pi^+ \rightarrow \mu^+ \rightarrow \beta^+$ DECAY PROCESS AND THE ENERGY SPECTRUM OF THE β^+. H. Bramson and W. W. Havens, Jr. Phys. Rev. 83, 861-2 (1951) Aug. 15. (Letter to the editor)

An investigation of the meson decay ($\pi^+ \rightarrow \mu^+ \rightarrow \beta^+$) is described in which a beam of mesons, produced by the 385-Mev Nevis cyclotron was incident to thick electron-sensitive emulsions in a collimating chamber. Studies have been made of 1185 cases of π^+ decay in which the μ's have ended in the emulsion. Photographs are given showing interesting example of μ^+ decay. The spectrum of β^+ from μ^+ decay was plotted and appears to have a marked nonzero cut off at the high-energy end. Using the Scott-Snyder theory and the relativistic momentum of the positron as equal to that of each neutrino, the mass of the μ meson was calculated to be 209.3 ± 2.2 m_e.

6363
INELASTIC SCATTERINGS OF π MESONS. M. H. Johnson. Phys. Rev. 83, 510-12(1951) Aug. 1.

The inelastic scattering of a π meson is considered the result of an elastic collision between a meson and a free nucleon. The nuclear model determines the initial nucleon momentum distribution and limits the possible final states. The energy and angular distribution of scattered mesons is obtained in terms of the scattering probability in relative coordinates, which depends only on the momenta of the meson relative to the struck nucleon. Energy distributions of the scattered mesons, calculated for several cases from the differential cross section, indicate that collisions in which the meson loses most of its kinetic energy are relatively infrequent. (auth)

6364
THE CAPTURE AND DECAY OF MESONS IN PHOTOGRAPHIC EMULSIONS. W. F. Fry. Phys. Rev. 83, 594-7 (1951) Aug. 1.

Meson events have been studied in Eastman NTB-3 plates which were exposed to cosmic radiation in the stratosphere by means of balloons. It is found that $68 \pm 7\%$ of the mesons

ending in the emulsion which do not produce stars or without associated secondary mesons decay with the emission of a high energy electron. Of these mesons, 11.6 ± 1.5% (presumably 23.2% of the negative mesons) have associated electrons with energies in the interval from 15 to 70 kev. The energy distribution of these electrons is well represented by a simple exponential with a mean energy of 17 kev. Electrons with energies in the interval from 15 to 70 kev are observed from 19.6 ± 4.0% of the stars caused by negative π-mesons. (auth)

6365

ON THE GENERATION OF MESONS. T. N. Khazanovich. Zhur. Eksptl'. i Teoret. Fiz. 21, 581-7(1951) May. (In Russian)

The cross section for the generation of mesons during capture of nucleons of high-energy photons is calculated in the nonrelativistic approximation. The mesons considered are neutral, both scalar and pseudoscalar. Several remarks are made on a possible analogous treatment of charged mesons. (auth)

6366

THE EFFECT OF BOHR ORBIT BINDING ON NEGATIVE μ-MESON β-DECAY. C. E. Porter and H. Primakoff. Phys. Rev. 83, 849-50(1951) Aug. 15. (Letter to the editor)

The effect of binding the negative μ meson into its lowest Bohr orbit on the negative electron momentum spectrum ($\mu^- \rightarrow e^- + 2\nu$) is calculated. The orbital motion of the μ^- meson, induced by the binding, results in a "Doppler smearing" of the e^- spectrum. The principal result is the prediction of a tailing of the e^- spectrum beyond the cut-off momentum appropriate to a meson which is free and stationary before decay.

6367

PRODUCTION OF NEUTRAL MESONS BY γ-RAYS INCIDENT ON HYDROGEN. A. Silverman and M. Stearns. Phys. Rev. 83, 853-4(1951) Aug. 15. (Letter to the editor)

The reaction $\gamma + H^1 \rightarrow \pi^0 + H^1$ has been investigated by bombarding thin polyethylene and carbon targets with bremsstrahlung radiation from the 310-Mev Cornell synchrotron. The reaction was observed by detecting coincidences between the recoil proton and one of the decay γ rays from the neutral meson. The energy and angle of the recoil proton were measured and these two quantities, combined with the conservation equations, uniquely determine the energy of the incident γ ray and the energy and angle of the neutral meson. In this manner it is possible to get the cross section for production of neutral mesons as a function of γ-ray energy despite the continuous spectrum of the incident radiation. The cross section for neutral-meson production at 90° (lab) is plotted as a function of the incident γ-ray energy.

6368

LOW ENERGY PHOTOMESON PRODUCTION IN HYDROGEN. S. D. Drell. Phys. Rev. 83, 555-60(1951) Aug. 1.

Berkeley experiments have revealed the general features of the neutral and charged π-meson photoproduction cross sections for gamma-rays incident on protons. In particular, approximate equality of the π^0 and π^+ production cross sections has been observed. This has proved difficult to account for theoretically. Calculations based on a weak coupling perturbation treatment of the meson-nucleon interaction predict the π^0 production to be reduced by $\sim(\mu/M)^2$ relative to π^+ production for energies at which the Berkeley experiments are performed (~320 Mev). In this report the perturbation-theory approximation of weak nucleon-meson coupling is avoided. By means of a canonical transformation of the type introduced by Bloch and Nordsieck, a solution to the hamiltonian equation that involves no assumption concerning the largeness or smallness of $g^2/4\pi$ is obtained. The approximations involved are neglect of nucleon recoil and treatment of spin and charge matrices as classical unit vectors. Handling the electromagnetic field by standard perturbation theory, this solution is used to calculate the matrix elements for photoproduction. In evaluating the matrix elements a finite source cutoff must be used to compensate neglect of nucleon recoil. Qualitative agreement with the observed equality of π^0 and π^+ production cross sections with a choice of $g^2/4\pi \sim 1-2$ and of source radius of the order of a nucleon Compton wavelength is obtained. Calculation of the anomalous nucleon magnetic moments corroborates a choice of these constants in this range. An angular distribution and energy dependence for the production cross sections in accord with observation is also obtained. (auth)

6369

THE τ-MESON. P. E. Hodgson. Phil. Mag. (7) 42, 1060-1 (1951) Sept.

Examination of a batch of 400 μ Ilford G5 plates exposed in a glacier provides further confirmation of the existence of τ mesons, and also gives some support to the view that these particles have a larger probability of being produced in hydrogen than in the other elements. The τ-meson mass appears to be 969 ± 15m_e.

6370

MASSES AND MODES OF DECAY OF HEAVY MESONS. PART I. κ-PARTICLES. C. O'Ceallaigh. Phil. Mag. (7) 42, 1032-39(1951) Sept.

Observations by the photographic method are described which establish the existence of heavy charged mesons, of mass about 1200m_e, which decay with the emission of a single charged particle. In one case, it is shown that the secondary charged particle is a μ meson of energy 5.9 Mev. In another, it is a particle of charge $|e|$ and of energy about 200 Mev. If the two particles are of the same type with similar modes of decay, then the charged secondary particle must be accompanied by at least two neutral particles. The question whether the κ particles are identical with the τ mesons which decay into three charged particles, is discussed. (auth)

6371

MASSES AND MODES OF DECAY OF HEAVY MESONS. PART II. τ-PARTICLES. P. H. Fowler, M. G. K. Menon, C. F. Powell, and O. Rochat. Phil. Mag. (7) 42, 1042-9 (1951) Sept.

Further evidence which establishes the existence of heavy charged mesons which decay into three charged particles is presented. It is shown that the three secondary particles are probably π particles, and that the mass of the parent mesons, called τ particles, is 966 ± 8m_e. The frequency of occurrence of κ and τ particles at the Jungfraujoch, in comparison with the number of π particles, is discussed, and it is shown that in the nuclear collisions involving protons of energy greater than 10 bev, a large fraction of the energy lost in the creation of mesons, must appear as κ and τ particles. The evidence suggests that the lifetime of the heavy mesons is about 10^{-9} sec. The most favorable conditions for the detection of the particles by the photographic method are discussed. (auth)

6372

ON THE SPIN OF THE μ MESON. E. R. Caianiello. Phys. Rev. 83, 735-40(1951) Aug. 15.

The behavior of a μ meson of spin ½ is investigated for the process $\mu \rightarrow e + 2\nu$, $\pi \rightarrow \mu + \nu$, $\mu^- + \text{"p"} \rightarrow \text{"n"} + \nu$. These processes have been chosen because they give direct information on the nature of the μ meson and do not require second quantization of the μ-meson field, which is not feasible for spin

values greater than 1 when electromagnetic interactions are present. The theory used to describe the μ meson is due to Rarita and Schwinger. The spectra for the $\mu \rightarrow e+2\nu$ decay are obtained for the same modes of decay considered by Tiomno and Wheeler for μ-mesons of spin ½. Their most relevant feature is that none of them goes to zero at maximum electron energy. It is to be hoped that more careful measurements of this spectrum will permit a decision on the spin value of the μ meson. The μ-capture is studied by assuming the process to happen via an intermediate scalar or pseudoscalar π meson. Comparison with the lifetime for $\pi \rightarrow \mu$-decay and use of experimental data allow an evaluation of the constant coupling the π meson to nucleons. The plausibility of this value is taken as a test for the plausibility of the assumed spin value of the μ meson. The results do not appear to contradict present-day evidence, due to the uncertainty of the nuclear matrix elements. The formulas obtained apply of course to any spin ½ particle undergoing similar processes. (auth)

6373
ZENITH ANGLE AND MOMENTUM SPECTRUM OF μ MESONS AT SEA LEVEL. Jacob L. Zar. Phys. Rev. 83, 761-7(1951) Aug. 15.

The zenith angle dependence of the μ-meson intensity at sea level has been measured for several values of momentum between 280 and 1080 Mev/c. Results were obtained by three methods: the coincidence, anticoincidence, and delayed coincidence methods, and it has been found that the shape of the zenith spectrum depended on which technique was used. The delayed coincidence method was capable of determining meson intensities in the presence of other types of penetrating particles. It suggests the existence of a considerable number of nonmesonic particles in the low energy region of the hard component.

The lifetime of the meson was computed from its anomalous absorption in the atmosphere. It was found to be 2.2 ± 0.3 μ sec. (auth)

MOLECULAR PROPERTIES

6374
Ames Lab.
ON THE THEORETICAL CALCULATION OF TRANSITION PROBABILITIES; by Harrison Shull and Frank O. Ellison. Sept. 27, 1951. 3p. (ISC-173)

The theoretical computation of transition probabilities for electric dipole transitions in electronic spectra of molecules requires the evaluation of the transition integral $\underline{Q} = \int \underline{\psi}_i \left(\sum_k^N \underline{r}_k \right) \underline{\psi}_f dv$ where $\underline{\psi}_i$ and $\underline{\psi}_f$ are the antisymmetrized and normalized N-electron wave functions of the initial and final states, respectively, and $\underline{r}_k$ is the radius vector of the kth electron referred to a system of coordinate axes. The transition probability is proportional to the square of $\underline{Q}$. Bayliss (Australian J. Sci. Research A3, 109(1950)) has suggested that it is necessary to choose the center of the system as an origin for $\underline{r}$. It is now shown that if the wave functions of the initial and final states are orthogonal to each, the transition integral is independent of the choice of origin of the dipole length operator. The actual calculation involves computation of one-electron integrals which may depend on the choice of origin. A unique origin should therefore be chosen although the final answer will be independent of this choice. It is pointed out that the calculations by Bayliss (J. Chem. Phys. 16, 287(1948)) of the transition probabilities for a one-dimensional electron gas in a field of uniform potential are correct, contrary to his statement in the Australian J. Sci. Research.

6375
DEPENDENCE OF MAGNETIC SHIELDING OF NUCLEI UPON MOLECULAR ORIENTATION. Norman F. Ramsey. Phys. Rev. 83, 540-1(1951) Aug. 1.

An expression is calculated for the dependence of the magnetic shielding of nuclei in linear molecules upon the magnetic quantum number of the molecule. The expression for the dependence upon orientation is shown to consist of two different terms. The first of these is directly related to the spin-rotational magnetic interaction constant of the molecule. Since the interaction is known experimentally in the important case of molecular hydrogen this term can directly be evaluated from the experimental measurements. The other term is proportional to $(3\zeta^2 - r^2)/r^3$ averaged over the electron coordinates in the molecule. This term can be calculated from the wave function of the hydrogen molecule. For molecular hydrogen, the dependence of the nuclear shielding upon the molecular orientation is in principle measurable. Such a measurement, combined with the theory of the paper, provides an important check on the molecular hydrogen wave function (see also NSA 4-5014). (auth)

6376
NUCLEAR PROTON RESONANCE IN RELATED LIQUID HYDROCARBONS. R. Bradford, C. Clay, A. Craft, E. Strick, and J. Underhill. Phys. Rev. 83, 656-7(1951) Aug. 1.

A preliminary investigation of the line-width parameter, T_2, for several long-chain hydrocarbons has been made with a Bloch crossed-coil type nuclear induction apparatus in an electromagnet with 12-in. diam pole faces. Results for line widths (gauss) and line-width parameters (seconds $\times 10^{-4}$), respectively, are: octadecane ($CH_3(CH_2)_{16}CH_3$), 0.37 and 1.0; hexadecane ($CH_3(CH_2)_{14}CH_3$), 0.29 and 1.3; tetradecane ($CH_3(CH_2)_{12}CH_3$), 0.15 and 2.7; dodecane ($CH_3(CH_2)_{10}CH_3$), 0.05 and 8.

6377
MOLECULAR CONSTANTS OF $Cs^{133}Cl^{35}$. R. G. Luce and J. W. Trischka. Phys. Rev. 83, 851-2(1951) Aug. 15. (Letter to the editor)

The radiofrequency spectra of cesium chloride were studied by means of the electric resonance method of molecular beam spectroscopy. Lines were observed arising from $J,m_J \rightarrow J,m_J'$ transitions 2,0 → 2,1; 3,0 → 3,1; 4,0 → 4,1; 4,1 → 4,2; and 5,1 → 5,2. Lines arising from molecules in six different vibrational states were resolved. Evidence for the quadrupole interaction of Cs and Cl was seen in the broad lines observed at low frequencies, but no fine structure due to these interactions could be resolved. The spectrum of the less abundant species of Cl could be discerned superimposed on the spectrum of the more abundant one in the predicted position. Molecular constants are calculated and maximum values for the interaction constant $|eqQ/h|$ of 3 and 4 Mc are derived for Cl and Cs, respectively.

NEUTRONS

6378
ON THE MOTION OF NEUTRONS IN HYDROGENOUS SUBSTANCES; trans. from Ricerca Scientifica VII, 2, 13 (1936). Enrico Fermi; tr. by G. M. Temmer. [nd] 38p. (NP-2385)

6379
Atomic Energy Project (Canada)
DETECTION OF SLOW NEUTRONS; by B. W. Sargent. Issued June 1950. 45p. (LP-27)

6380
NEUTRON DIFFRACTION BY PARAMAGNETIC AND ANTIFERROMAGNETIC SUBSTANCES. C. G. Shull, W. A. Strauser, and E. O. Wollan. Phys. Rev. 83, 333-45(1951) July 15.

Neutron scattering and diffraction studies on a series of paramagnetic and antiferromagnetic substances are reported in the present paper. The paramagnetic diffuse scattering predicted by Halpern and Johnson has been studied, resulting in the determination of the magnetic form factor for Mn^{++} ions. From the form factor, the radial distribution of the electrons in the 3d-shell of Mn^{++} has been determined, and this is compared with a theoretical distribution of Dancoff. Antiferromagnetic substances are shown to produce strong, coherent scattering effects in the diffraction pattern. The antiferromagnetic reflections have been used to determine the magnetic structure of the material below the antiferromagnetic Curie temperature. For some substances the magnetic unit cell is found to be larger than the chemical unit cell. The temperature dependence of the antiferromagnetic intensities has been studied, and the directional effects which characterize neutron scattering by aligned atomic moments have been used to determine the moment alignment with respect to crystallographic axes. From studies with magnetic ions possessing both orbital and spin moments, it is found that the antiferromagnetic intensities contain partial orbital moment components along with the spin moment component. The degree of orbital moment contribution agrees satisfactorily with that predicted by models of lattice quenching. (auth)

NUCLEAR PHYSICS

6381

Oak Ridge National Lab.

ON THE THEORY OF THE INNER BREMSSTRAHLUNG IN β-PROCESSES; by J. M. Jauch. Issued Sept. 24, 1951. 29p. (ORNL-1102)

The theory of the continuous soft γ radiation resulting from inner bremsstrahlung is developed for β decay and K-capture. For the case of ordinary β decay this is partly a repetition of previous work; the case of K-capture is a slight improvement of older work. Preliminary measurements on the continuous γ radiation in the K-capture of Fe^{55} are analyzed, and the feasibility of the method is demonstrated.

6382

Purdue Research Foundation

RESEARCH IN NUCLEAR PHYSICS; PROGRESS REPORT NO. I. June 15, 1951. 43p. (AECU-1560)

Progress is reported on the following incomplete investigations: a check of the excitation curves of (α,n) and $(\alpha,2n)$ reactions on Ag^{109}, symmetrical fission of U with Li + D or Be + D neutrons, and excitation of nuclei by the electromagnetic field of α particles. Various published papers on angular correlation measurements and decay schemes are included in their entirety.

6383

Radiation Lab., Univ. of Calif.

SUMMARY OF THE RESEARCH PROGRESS MEETING OF APRIL 12, 1951; by Bonnie E. Cushman. Sept. 11, 1951. 5p. (UCRL-1246)

The decay constants for rare-earth α emitters, Gd^{148}, Eu^{147}, and Sm^{147}, have been calculated by several theoretical methods. The results are tabulated and compared with experimental values.

Photomesons from Be have been studied. Mesons were detected at 90° with photographic emulsions and the ratio π^-/π^+ was determined by observing the number of stars (π^-) and π^+-μ decays in the same region of the plate. Ratios are as follows: 30 to 40 Mev, 2.5 ± 0.6; 40 to 55 Mev, 2.0 ± 0.3; 55 to 70 Mev, 2.2 ± 0.3.

6384

EXPERIMENTS WITH MODELS ON PROBLEMS OF THE DROP MODEL OF THE ATOMIC NUCLEUS. Erwin Saar. Ann. Physik (6) 8, 253-69(1951) Feb. 15. (In German)

Bohr and Wheeler (Phys. Rev. 56 (1939)) have resorted to the drop model of the nucleus for an explanation of fission processes, and Flügge (Ann. Physik (5) 32) used the same model for the calculation of the lifetime of γ-emitting excited nuclei. In experiments reported here analogies to the foregoing phenomena were obtained with the aid of liquid drops and soap bubbles brought to vibration by the action of a-c. A theoretical study of the analogies under consideration and of various factors involved, such as that of the electric charge and the viscosity of the liquid models, is followed by a description of the experiments which in many respects confirmed the applications of the drop theory of the nucleus.

6385

BINDING ENERGY SURFACES IN THE REGION OF THE MAGIC NUMBERS Z = 82 AND N = 126. Physica 17, 628-36(1951) June.

Binding energies of Hg, Tl, Pb, and Bi isotopes with masses between 203 and 211 have been calculated taking into account a new value of the n−H mass difference and new binding and reaction energies. The influence of the magic number is shown in sections of the energy surfaces. For some purposes this effect may be represented by a bell-shaped addition to the Bethe-Weiszäcker formula.

6386

ON THE UTILIZATION OF INTERVALS IN NUCLEAR EMULSIONS SENSITIVE TO ELECTRONS. Michel Renardier and Yvette Avignon. Compt. rend. 233, 393-5(1951) July 30. (In French)

It is found that, in using gaps in minimum-ionization tracks as a criterion for the identification of particles, the mere counting of the gaps is sufficient, no better differentiation being obtained by precise measurements of the lengths of the intervals. (auth)

6387

ON GAMOW'S CONVOLUTIONS OF THE ENERGY VALLEY. O. Monecke. Experientia 7, 255-7(1951) July 15. (In German)

The valley-shaped surface representing the function E = f(N,Z), where E is the binding energy, N the number of neutrons, and Z the number of protons in a nucleus, exhibits, as has been pointed out by Gamow, meanderings or convolutions of its bottom; Gamow thought that the probable number of these convolutions was 7 or 8. By limiting the survey to isotopes of odd mass numbers, and by examining separately valleys corresponding either to even or to odd N, the author found that the number of convolutions is exactly 6, and that a fine structure is superimposed upon them, due perhaps to spin-dependent nuclear forces. A theory of the isotope systematics outlined here has been presented in Experientia 5, 440(1949).

6388

NUCLEAR SHELL STRUCTURE AND NUCLEAR DENSITY. L. M. Yang. Proc. Phys. Soc. (London) 64A, 632-8(1951) July.

Correlations between the nuclear shell structure and the density distribution are analyzed on the assumption that the former is associated with the successive appearance of particles of higher angular momentum. General requirements for the possible form of the nuclear density distribution are derived. It is shown that a reasonable density distribution conforming with the foregoing requirements and other known facts reproduces unmistakably the "magic numbers." (auth)

6389
INTERACTIONS BETWEEN NEUTRON AND PROTON. P. Swan. Australian J. Sci. Research 3A, 519-31(1950) Dec.

An attempt has been made to find an interaction between neutron and proton which will account for not only the binding energy and quadrupole moment of the deuteron and the low energy scattering data, but also the results of the experiments on the scattering of 90-Mev neutrons by protons. Three types of modification of the triplet neutron-proton interaction have been used which embody the following features: (1) A noncentral potential of spherical well form, whose radius of interaction is varied. (2) A noncentral potential whose form is closer to that of the pseudoscalar meson potential than the usual Rarita-Schwinger form, but which does not possess the objectionable singularities of the former. (3) The inclusion of a large short-range repulsion. In each case exchange forces of the usual types have been used. The results obtained, like those of other workers in this field using different forms of interaction, fail to agree with the high energy data. (auth)

6390
THE INTERACTION OF THE DIRAC MAGNETIC MONOPOLE WITH MATTER. W. V. R. Malkus. Phys. Rev. 83, 899-905(1951) Sept. 1.

It has been previously determined that an electron has no bound states in the field of the magnetic monopole. Seeking to establish the character of the monopole's interaction with the more complex fields of atoms and molecules, this paper investigates charged particles, of arbitrary magnetic moment, moving simultaneously in the field of the monopole and an external electric field. It is concluded that the monopole can be coupled to matter with energies comparable to, but not significantly greater than, the chemical bond, reservations being made in the case of hydrogen where the lowest energy state depends upon the mass of the monopole.

Speculation regarding the creation of monopoles by primary cosmic radiation and their consequent motion in the earth's magnetic field instigated an experimental attempt to arrive at an upper limit for the rate of such creation. The results of this experiment determine that the number of monopoles arriving at the surface of the earth is less than 10^{-10} per cm^2 per sec. (auth)

6391
INFLUENCE OF PHASE MEMORY OF A SPIN SYSTEM OF THE SHAPE OF NUCLEAR-RESONANCE SIGNALS. Robert Gabillard. Compt. rend. 233, 39-41(1951) July 2. (In French)

Overlapping of signals, due to phase memory, permits the measuring of the relaxation time in some cases in spite of limitations due to the nonhomogeneity of the magnetic field. The possible use of the procedure is limited, however, by a difficulty of another kind, revealed by experimental evidence.

6392
THEORETICAL STUDIES IN NUCLEAR STRUCTURE. II. NUCLEAR d^2, d^3 AND d^4 CONFIGURATIONS. FRACTIONAL PARENTAGE COEFFICIENTS AND CENTRAL FORCE MATRIX ELEMENTS. H. A. Jahn. Proc. Roy. Soc. (London) 205A, 192-237(1951) Feb. 7.

The orbital and charge-spin fractional parentage coefficients for the nuclear d^3 and d^4 configurations are derived using group theory. The orbital coefficients are given in a form appropriate to the new subclassification of the states according to irreducible representations of R_3 discussed in part I (Jahn, Proc. Roy. Soc. (London) 201A, 516(1950)). Using these coefficients the complete energy matrices for the d^3 and d^4 configurations are derived, for a general charge-symmetric central two-body interaction, from the known energy matrix for the d^2 configuration. (auth)

6393
THEORETICAL STUDIES IN NUCLEAR STRUCTURE. III. RADIAL INTEGRALS FOR THE NUCLEAR s, p, AND d SHELLS. W. J. Swiatecki. Proc. Roy. Soc. (London) 205A, 238-46(1951) Feb. 7.

In working out nuclear energy levels on the Hartree approximation certain integrals are met involving the interaction potential and the particle radial wave-functions. In this note these integrals are defined and worked out for the 1s, 2p, 3d wave-functions of a three-dimensional oscillator using as interaction potential (a) the Gauss potential, (b) the meson potential. (auth)

6394
GRAPHICAL REPRESENTATION OF THE INTEGRAL IN BLOCH'S EQUATIONS. Yves Ayant. Compt. rend. 233, 245-7(1951) July 16. (In French)

Bloch's equations giving one of the components of the macroscopic nuclear moment can be formally solved for certain parameters. The solution involves a graphical representation having the properties of Cornu's spiral and indicating by inflexions every passage through a resonance.

6395
PERTURBATIONS OF THE "PHASE MEMORY" OF A SYSTEM OF SPINS, CAUSED BY FLUCTUATIONS OF THE MAGNETIC FIELD. Robert Gabillard. Compt. rend. 233, 307-9(1951) July 23. (In French)

Continuing a theoretical and experimental study of the role played by phase memory in nuclear magnetic resonances (Compt. rend. 233, 39(1951)), an examination is made of the effect of fluctuations of the various magnetic fields involved, viz., fluctuations of the principal field, those of the sweeping field, and those due to the Brownian movement of the molecules of the sample.

NUCLEAR PROPERTIES

6396
Brookhaven National Lab.
TOTAL CROSS SECTIONS OF CARBON AND HYDROGEN FOR 14-MEV NEUTRONS; by H. L. Poss, E. O. Salant, and L. C. L. Yuan. Aug. 10, 1951. 1p. (AECU-1622)

The report is reproduced here in its entirety.

Carbon and hydrogen total cross sections for 14-Mev neutrons (Salant and Ramsey, Phys. Rev. 57, 1075(1940); Ageno et al., Phys. Rev. 71, 20(1947); Sleator, Phys. Rev. 72, 207(1947)) were redetermined to a probable error of 1%. Thick zirconium-tritium targets were bombarded by 400 kev deuterons of Department of Terrestrial Magnetism's electrostatic generator. Neutrons were detected by a terphenyl-xylene scintillation counter, efficiency 5% (Falk, Poss, and Yuan, Phys. Rev. 83, 176(1951)). They were monitored by counting the α particles from the reaction. Source to detector distance: 40 in.; scatterer diameter: 1 in. so that only 0.2% of incident neutrons were scattered into detector for the thickest scatterer. Counting rate was about 2000/min. Neutron background of 6% was determined with a 13-in. copper cylinder in neutron beam. A least-squares analysis of the transmissions of six thicknesses each of carbon and polyethylene (40 to 85% transmission) gives the following total cross sections: $\sigma_c = 1.279 \pm 0.004$ b, $\sigma_H = 0.689 \pm 0.005$ b for an effective neutron energy evaluated to be 14.08 ± 0.05 Mev (Snow, in press).

6397
Brookhaven National Lab.
NEUTRON REFRACTION IN O_2, N_2, He, A GASES; by A. W. McReynolds. June 14, 1951. 14p. (AECU-1635)

The index of neutron refraction of oxygen, nitrogen, helium, and argon has been studied by reflection of a neutron beam from a liquid-gas interface and observation

of decreasing reflectivity with increasing gas pressure. Results verify that the index for gases is given by the same formulas which hold for liquids and solids. Comparative measurements of the different gases then give values for the coherent bound scattering cross sections: assuming oxygen = 4.2 barns as a standard, nitrogen = 11 barns, helium = 1.1 barns, argon = 0.5 barn. (auth)

6398

Wisconsin Univ.

CLASSIFICATION OF LEVELS IN Al^{25}; by L. J. Koester. [nd] 1p. (AECU-1618)

The report is reproduced here in its entirety.

A phase shift analysis (Koester, Goldberg, Kaufmann, Mooring, and Saxon, Phys. Rev. 83, 219A) of the elastic scattering of protons by Mg^{24} has been completed. This work has yielded information regarding the angular momentum and parity quantum numbers of levels observed in Al^{25}. In the region of bombarding energies between 0.4 and 3.4 Mev, the general trend of the differential scattering cross section is well fitted by a combination of the effects of potential scattering (including Coulomb) and of the three observed broad resonances. The parities, relative to Mg^{24}, of most of the narrow resonances are determined. A two-fold ambiguity remains in their angular momentum quantum numbers because the experimental resolution was not sufficient to give the true maximum cross sections of the very narrow peaks. These excited states of Al^{25} are considered from the viewpoint of the shell model of the nucleus.

6399

Wisconsin Univ.

TOTAL CROSS SECTIONS OF HEAVY NUCLEI FOR FAST NEUTRONS; by D. W. Miller, R. E. Fields, and C. K. Bockelman. [nd] 1p. (AECU-1614)

The report is reproduced here in its entirety.

The total cross sections of 23 heavy nuclei from Fe to Bi were determined as a function of neutron energy. Monoenergetic neutrons in the energy range from 0.02 to 3.2 Mev were obtained by bombardment of thin Li or Zr-T targets with protons from the electrostatic generator. Total cross sections of the closed-shell nuclei Sr, Y, Ba, La, Ce, and Pr were measured at intervals of 0.02 Mev from 0.02 to 1.4 Mev, and at about 0.15 Mev intervals from 1.4 to 3.2 Mev. In addition, earlier results obtained at Wisconsin below 1.4 Mev for 15 other heavy nuclei were extended to 3.2 Mev using about 0.15 Mev spacing between points. A broad maximum occurs in the total cross sections of the heavier elements. This maximum appears to move to higher neutron energies with increasing mass number.

6400

Oak Ridge National Lab.

THE TOTAL NEUTRON CROSS SECTION OF HOLMIUM AS A FUNCTION OF ENERGY; by T. E. Stephenson. Issued Oct. 3, 1951. 77p. (ORNL-1068)

The total neutron cross section of Ho has been measured as a function of neutron energy in the range 0.026 to 0.5 ev by the transmission method. A neutron crystal spectrometer was used to obtain beams of nearly monochromatic neutron wavelength or energy. A BF_3 counter was placed in the beam to count the neutrons with and without the anhydrous Ho_2O_3 sample in the beam. The cross-section results are plotted vs. neutron energy. A crystalline diffraction peak was found near 0.06 ev and a group of peaks near 0.03 ev. A total cross section of 89 barns at 0.03 ev was found. The absorption cross section for thermal neutrons (average energy 0.025 ev) was reported (H. Pomerance, to be published) as 64 barns. The effect of paramagnetic scattering is considered as a means of explaining the discrepancy.

6401

MOLECULAR AND NUCLEAR MAGNETIC MOMENTS IN MICROWAVE ZEEMAN SPECTRA. C. K. Jen. Physica 17, 378-85(1951) Mar.-Apr.

The molecular moment, which results from rotation, can be directly determined from the Zeeman splitting if the molecule is not electronically paramagnetic and is free from any nuclear coupling. Experimental data on the rotational moments of H_2O, NH_3, HDO, N_2O, SO_2, and OCS are presented. Results of a quantum mechanical theory of the rotational moment in a symmetric top molecule are summarized. In the case of a nuclear coupling, the Zeeman spectra of the rotational fine-structure lines are analyzable in terms of the combined effect of the nuclear and molecular (rotational) magnetic moments. The nuclear spin and magnetic moment of I^{129} were determined by the microwave Zeeman effect as 7/2 and 2.72 nuclear magnetons, respectively, Gordy et al. (Phys. Rev. 76, 443(1949)), and a spin of 3/2 and nuclear moment of 0.63 ± 0.02 nuclear magnetons was obtained for S^{33} by Townes and Geschwind (Phys. Rev. 74, 626(1948)).

6402

DETERMINATION OF NUCLEAR PROPERTIES BY MICROWAVE SPECTROSCOPY. C. H. Townes. Physica 17, 354-77(1951) Mar.-Apr.

A general discussion is given of the technique of microwave spectroscopy and its use in determination of mass ratios, nuclear quadrupole moments and coupling constants, and nuclear gyromagnetic ratios. No new experimental data are given, but a rather comprehensive review of published results is included. All spin values determined or confirmed by microwave methods are tabulated. 45 references. 7 tables.

6403

NUCLEAR MAGNETIC RESONANCE MEASUREMENTS ON Be^9, Al^{27}, and Si^{29} in BERYL. J. Hatton, B. V. Rollin, and E. F. W. Seymour. Phys. Rev. 83, 672-3(1951) Aug. 1. (Letter to the editor)

Measurements have been made of nuclear magnetic resonance absorption in a single crystal of beryl ($Be_3Al_2Si_6O_{18}$) at a frequency of 2.3 Mc and a temperature of 20°K. Five lines due to electric quadrupole splitting of the Al^{27} resonance and three lines due to Be^9 were found. With the hexagonal axis of the crystal parallel to the magnetic field, the separation between adjacent lines for Al was 0.45 Mc, and for Be, 0.13 Mc. A spin of 3/2 for Be^9 was confirmed. A very weak resonance was also observed at a field corresponding to a g factor of 1.11 and was tentatively assigned to Si^{29}.

6404

THE ISOMERIC LEVEL OF Cd^{111m}. Carl L. McGinnis. Phys. Rev. 83, 686-7(1951) Aug. 1. (Letter to the editor)

The 48-min isomeric level of Cd^{111} at 396 kev is assigned a spin of 11/2, contrary to the author's earlier assignment of 13/2 and even parity (Phys. Rev. 81, 734(1951)). Cd^{111m} decays by the emission of a 149-kev γ ray followed by a 247-kev γ. The γ-ray ratio 149/247 was measured as 0.33 ± 0.06 by observing the Cd^{111m} photoelectron spectrum from a gold radiator. In addition the ratio of the number of In^{111} decays to the 396-kev level to the number of decays to the 419-kev level was determined as 1×10^{-4} (within a factor of 2) by extracting chemically the 48-min Cd from the 2.84-day In. Both of these ratios are consistent with a spin of 11/2. The 149-kev γ ray is described as 2^3 electric.

6405

ISOTOPIC SHIFT IN THE SPECTRUM OF SILVER AND NUCLEAR MAGNETIC MOMENTS OF Ag^{107} AND Ag^{109}.

P. Brix, H. Kopfermann, R. Martin, and W. Walcher. Z. Physik 130, No. 1, 88-99(1951) May 28. (In German)

An account of this work, published in Naturwissenschaften 38, 68(1951), was abstracted in Nuclear Science Abstracts as abstract 5-4533.

6406

CALCULATION OF NUCLEAR MAGNETIC MOMENTS. Masataka Mizushima and Minoru Umezawa. Phys. Rev. 83, 463(1951) July 15. (Letter to the editor)

Magnetic moments of the following nuclei were calculated by means of the j-j coupling shell model: H^3, He^3, B^{11}, C^{13}, N^{15}, O^{17}, F^{19}, Al^{27}, P^{31}, S^{33}, K^{39}, Li^7, Be^9, Cl^{35}, and Mg^{25}. The calculated values agree very well with experimental measurements (J. E. Mack, Revs. Modern Phys. 22, 64(1950)) and some conclusions are made about nuclear forces. The results are compatible with neutral and symmetrical meson theory, but charged-meson theory is excluded. Magnetic moments are also predicted for Be^7, B^9, $A^{35, 37}$, Al^{25}, and K^{37}, for which experimental measurements have not been made.

6407

QUADRUPOLE MOMENTS OF COPPER 63 AND 65. B. Bleaney, K. D. Bowers, and D. J. E. Ingram. Proc. Phys. Soc. (London) 64A, 758-9(1951) Aug. (Letter to the editor)

Hyperfine structure in the paramagnetic-resonance spectrum of the copper Tutton salts has been studied. Crystals of copper potassium sulfate with most of the Cu ions replaced by diamagnetic Zn ions were grown in heavy water. Interpretation of the spectra of such crystals yielded values of the nuclear quadrupole moments of $-0.12_7 \pm 0.01 \times 10^{-24}$ cm^2 for Cu^{63} and $-0.117 \pm 0.01 \times 10^{-24}$ cm^2 for Cu^{65}.

6408

RESONANCES IN (γ,n) PROCESSES. Michael Danos. Z. Naturforsch. 6a, 218-19(1951) Apr. (Note; in German)

Additional considerations are presented on the theory of Steinwedel et al. (Z. Naturforsch. 5a, 413(1950)), Jensen et al. (ibid., 5a, 343(1950)), and the present author (ibid., 6a, 217(1951)), explaining resonances in (γ,n) processes by a common oscillation of all protons against all neutrons in the drop model of the nucleus. Since in the experiments which led to that theory γ radiations from Li were used, the role of each of the two Li γ rays is discussed. The damping width of the resonance lines is considered. Changes brought about in the theory by interpreting rest masses of nucleons as meson-field energies are explained.

6409

ELECTROMAGNETIC PROPERTIES OF NUCLEI AND NUCLEAR STRUCTURE. L. Rosenfield. Physica 17, 461-83(1951) Mar.-Apr.

The shell structure of nuclei is discussed according to the Jensen-Mayer scheme of individual nucleon levels. Then the effect of nuclear structure on electromagnetic interactions is considered. The third part of the paper deals with spin-orbit couplings in light nuclei. One of the main conclusions which emerges from the evidence analyzed is the existence of spin-orbit couplings much stronger than the relativistic interactions of this type. It is suggested that a meson of larger mass than the π meson might be of the vector type and thus responsible for the large nuclear spin-orbit forces.

6410

PARAMAGNETIC RESONANCE IN VANADOUS AMMONIUM SULPHATE. B. Bleaney, D. J. E. Ingram, and H. E. D. Scovil. Proc. Phys. Soc. (London) 64A, 601-8(1951) July.

In the solid state the orbital momentum of the divalent vanadium ion $3d^3$ is quenched by the cubic crystalline field, leaving a spin quadruplet as the ground state. Paramagnetic resonance measurements show that in $V(NH_4)_2(SO_4)_2.6H_2O$ this is split into two doublets with a separation of 0.36 cm^{-1} by a component of the crystalline field with rhombic symmetry. An extensive and isotropic hyperfine structure is observed, from which the value of 7/2 for the nuclear spin of ^{51}V is confirmed. The contribution from the observed splittings to the tail of the magnetic specific heat curve is evaluated. (auth)

6411

THE MAGNETIC MOMENT OF S^{33}. S. S. Dharmatti and H. E. Weaver, Jr. Phys. Rev. 83, 845(1951) Aug. 15. (Letter to the editor)

Employing the nuclear induction spectrometer, signals of S^{33} with a natural line width of about 1 gauss were detected in chemically pure CS_2. The value of the magnetic moment was found to be $\mu(S^{33}) = +0.64292 \pm 0.00014$.

6412

LOWER LIMIT FOR THE LIFETIME OF THE 0.8-MEV EXCITED LEVEL OF Mo^{96}. Franz R. Meitzger. Phys. Rev. 83, 842(1951) Aug. 15. (Letter to the editor)

A NaI scintillation counter was used to measure the γ radiation scattered from Mo^{96}. The γ-ray width of the 0.8-Mev transition to the ground state is $\leq 10^{-2}$ ev. From this the half life of the 0.8-Mev excited state of Mo^{96} was found to be $T_{1/2} \geq 0.5 \times 10^{-13}$ sec.

6413

MAGNETIC MOMENTS OF EVEN-ODD NUCLEI. F. Bloch. Phys. Rev. 83, 839-40(1951) Aug. 15. (Letter to the editor)

An interpretation of the magnetic moments of even-odd nuclei which is compatible with a strict adherence to the shell model is proposed. The intrinsic magnetic moment of the odd nucleon is affected by the binding of the core; depending upon the nucleus, it can differ by an appreciable amount from the magnetic moment of the free nucleon. The effective intrinsic moment μ' of the odd nucleon is calculated from the Landé formula for an even-odd nucleus with magnetic moment μ and spin I and for both values of the orbital quantum number $l = I \pm \frac{1}{2}$. A graph is given showing for both odd-proton and odd-neutron nuclei the corresponding deviations of the intrinsic moment from its magnitude in the free nucleon against the number of odd nucleons up to 83. A discussion of the graph is given in the light of current theories and the interpretation presented herein.

6414

TOTAL CROSS-SECTIONS OF THE ELEMENTS FOR 156-MEV NEUTRONS. A. E. Taylor, T. G. Pickavance, J. M. Cassels, and T. C. Randle. Phil. Mag. 42, 751-5(1951) July.

Measurements have been made of the total cross sections of 10 elements for neutrons of effective energy 156 ± 3 Mev. The results are as follows (in units of 10^{-24} cm^2): H, 0.0464 ± 0.0012; D, 0.0707 ± 0.002; Be, 0.258 ± 0.014; C, 0.330 ± 0.003; O, 0.430 ± 0.004; Al, 0.677 ± 0.011; Fe, 1.238 ± 0.016; Cu, 1.376 ± 0.018; Ba, 2.476 ± 0.088; and Pb, 3.499 ± 0.026. The results are discussed in the light of the theory of Ferbach et al. (Phys. Rev. 75, 1352(1949)).

6415

MEASUREMENT OF THE MAGNETIC MOMENT OF THE PROTON IN BOHR MAGNETONS. J. H. Gardner. Phys. Rev. 83, 996-1004(1951) Sept. 1.

An experimental determination of the ratio of the precession frequency of the proton, $\omega_p = \mu_p H_0$, to the cyclotron frequency $\omega_e = eH_0/mc$ of a free electron in the same magnetic field has been carried out. The result, ω_p/ω_e, is the magnitude of the proton magnetic moment, μ_p, in Bohr magnetons, since $\gamma_p = 2\mu_p/\hbar$. Possible sources of systematic error were carefully investigated and in view of the results of this investigation and the high internal consistency of the data it is thought that the true ratio, uncorrected for diamagnetism, lies within the range $\omega_e/\omega_p = 657.475 \quad 0.008$.

If the diamagnetic correction to the field at the proton for the hydrogen molecule is applied here, the proton moment in Bohr magnetons becomes $\mu_p = (1.52101 \pm 0.00002) \times 10^{-3}$ ($e\hbar/2mc$). (auth)

6416

ABSORPTION OF 280-MEV PHOTONS. J. W. DeWire, A. Ashkin, and L. A. Beach. Phys. Rev. 83, 505-9(1951) Aug. 1.

Total cross sections for 280-Mev photons have been measured for a number of elements. The source of photons was the bremsstrahlung spectrum of 310-Mev upper limit, which was obtained from the Cornell synchrotron. Photons above 250 Mev were detected by a pair spectrometer and the transmission through various samples determined. The measured cross sections in units of cm^2/g are 0.01060, 0.0284, 0.0528, 0.0776, 0.1069, and 0.1148 for Be, Al, Cu, Sn, Pb, and U, respectively. The probable statistical errors range from 0.9 to 1.4%. These values are lower than the theoretical values by a fraction which is roughly proportional to Z^2 and is about 10% for Pb, in agreement with other results obtained at lower energies. (auth)

6417

THERMAL NEUTRON CAPTURE CROSS SECTIONS. H. Pomerance. Phys. Rev. 83, 641-5(1951) Aug. 1.

The Oak Ridge pile oscillator has been used for a survey of the thermal neutron capture cross sections of the elements. Sixty-nine elements from atomic number 3 to 82 have been measured by comparison with gold, whose capture cross section is known from other experiments. From the internal consistency of the measurements, the care in selecting samples, and the accuracy of the value for gold, these values are estimated to be accurate within 5%. A comparison is made with the results of other pile oscillator measurements and of other methods such as time-of-flight and activation. (auth)

6418

MASSES OF LIGHT NUCLEI FROM NUCLEAR DISINTEGRATION ENERGIES. C. W. Li, Ward Whaling, W. A. Fowler, and C. C. Lauritsen. Phys. Rev. 83, 512-18(1951) Aug. 1.

Values of the atomic masses from n^1 to F^{20} have been derived from the Q-values of nuclear reactions with a procedure of statistical adjustment. Tables are given of several fundamental mass differences, the most probable Q-values, and the atomic masses. Some disparity with the mass spectroscopic results is noted. (auth)

6419

MEASUREMENT OF THE F^{19} MAGNETIC MOMENT. T. Kanda, Y. Masuda, R. Kusaka, Y. Yamagata, and J. Itoh. Phys. Rev. 83, 1066(1951) Sept. 1. (Letter to the editor)

A precision measurement of the ratio of the magnetic moment of the proton to that of the fluorine nucleus in HF aq (22 % solution) has been carried out using the magnetic resonance method. The ratio of the magnetic moment of the fluorine nucleus to that of the proton with the sample of HF aq is, without diamagnetic correction, 0.940814 ± 0.000009.

6420

ON THE DEVIATIONS OF MAGNETIC MOMENTS FROM THE SCHMIDT LINES. A. de-Shalit. Helv. Phys. Acta 24, 296-7(1951) July 10.

In a plot μ vs. I for odd nuclei, experimental magnetic moments lie inside the region bound by the two Schmidt lines, but outside that determined by the two Dirac lines; the former lines are obtained by taking as the g_s factor its experimental value for a free nucleon, whereas the calculation of the latter pair of lines involves the g_s factor derived from the Dirac equation. It is thus possible that the deviations from the Schmidt lines could be explained by assuming that the abnormality in the g factor of the free nucleons, which probably comes from their additional mesonic field, is reduced when the nucleons are bound to the core.

6421

THE ABSOLUTE ENERGY LOSS OF 18-MEV PROTONS IN VARIOUS MATERIALS. Donald C. Sachs and J. Reginald Richardson. Phys. Rev. 83, 834-7(1951) Aug. 15.

The absolute energy loss of 17.77 ± 0.03-Mev protons upon passing through various materials was measured using the U.C.L.A. 41-in. F-M cyclotron. A ribbon foil of thorium, mounted inside the dee, was used to deflect the circulating proton beam above the median plane of the cyclotron magnetic field. This scattered beam of protons, confined to a plane above the median plane, described a circular path in the magnetic field through a slit system. At the 180° point, the beam was made to pass through a thin metallic foil. The protons traveled an additional 210° to an ionization chamber detector. It was possible to move the detector to different cyclotron radii. The displacement of the proton intensity distribution caused by the presence of the metallic foil was a measure of the absolute energy loss in the foil. It was possible to calculate the stopping power and the mean excitation potential for each material investigated. The results for aluminum yield a value of 156 ± 3 electron volts for the mean excitation potential. Other materials examined included Ni, Cu, Rh, Ag, Cd, Sn, Ta, Au, and Nylon.

Some information was obtained concerning the corrections to be applied to the stopping power formula; hence, the variation of these corrections with the atomic number of the stopping material was determined. (auth)

6422

PRECISE DETERMINATION OF THE MAGNETIC MOMENT OF THE DEUTERON. Bernard Smaller. Phys. Rev. 83, 812-20(1951) Aug. 15.

A precision measurement of the ratio of the magnetic moment of the proton to that of the deuteron has been carried out by the magnetic resonance method. The apparatus is described. The measurements were made using mixtures of H_2O and D_2O and also mixtures of H_2 and D_2 gas. The result for the H_2O:D_2O mixture is $\mu_H/\mu_D = 3.2571999 \pm 0.0000012$, while for the H_2:D_2 mixture it is $\mu_H/\mu_D = 3.2571990 \pm 0.0000010$. (auth)

6423

ON THE BINDING ENERGIES OF LIGHT NUCLEI. Jyumpei Sanada and Yasukazu Yoshizawa. Phys. Rev. 83, 663(1951) Aug. 1. (Letter to the editor)

The binding energies of the last nucleon or the last neutron-proton pair have been studied using the masses of nuclei having neutron excess T = N − Z = 0 or 1, where N and Z are the number of neutrons and protons, respectively. It can be seen from the graphs that the larger binding energies and the discontinuities like shell closing are at N or Z = 6 and 14. The larger binding energies at A = 27 or 29 are probably due to the shell closing at N or Z = 14, respectively; and at A = 61 there is an indication of the shell closing at Z = 28. No evidence of shell closing at 20 nucleons was found.

6424

THE THEORY OF PARAMAGNETIC RESONANCE IN HYDRATED COBALT SALTS. A. Abragam and M. H. L. Pryce. Proc. Roy. Soc. (London) 206A, 173-91(1951) Apr. 10.

The theory of a previous paper is applied to the paramagnetic resonance of certain cobalt salts. The splitting of the orbital levels by the crystalline field is first investigated, and then the further splitting by the spin-orbit interaction. The g-values so derived are in good agreement with experiment. The magnitude of the hyperfine splitting is also in good agreement.

6425
THE THEORY OF THE NUCLEAR HYPERFINE STRUCTURE OF PARAMAGNETIC RESONANCE SPECTRA IN THE COPPER TUTTON SALTS. A. Abragam and M. H. L. Pryce. Proc. Roy. Soc. (London) 206A, 164-72(1951) Apr. 10.

The general theory of a previous paper (Abragam and Pyrce, Proc. Roy. Soc. (London) 205A, 135(1951)) is applied to the copper Tutton salts. It is found that unless account is taken of the effect of admixed configurations containing unpaired s-electrons, agreement with experiment is impossible. Allowance for unpaired s-electron configurations gives good agreement, both for anisotropy and magnitude of the effect. The effect of the nuclear quadrupole moment, though small, is important, and the paramagnetic resonance method is in principle perhaps capable of giving a more accurate value of this nuclear constant than optical methods. (auth)

NUCLEAR REACTORS

6426
Brookhaven National Lab.
REACTOR SCIENCE AND ENGINEERING, p.82-93 of QUARTERLY PROGRESS REPORT; APRIL 1–JUNE 30, 1951. Issued Aug. 1951. 12p. (BNL-117(p.82-93))

Power level of the pile during this period is reported, utilization of high-activity wastes is discussed, and the effect of heat-treatment on the fixation of Ce^{144} and Cs^{134} in montmorillonite is related to the problem of permanent disposal of radioactive wastes. Resonances in In, Rh, Ir, and Au as determined with the neutron monochromator and double-crystal spectrometer are tabulated. Meteorological and geological studies related to waste disposal are summarized.

6427
MEASUREMENT OF THE NEUTRON TEMPERATURE IN THE REFLECTOR OF A HEAVY WATER PILE. A. Ertaud and R. Beaugé. J. phys. radium 12, 580-4(1951) May. (In French)

The temperature of the neutrons at various points in the Châtillon pile reflector has been determined by transmission through $1/v$ absorbers. The neutron spectrum is considered Maxwellian. The energy at which the 1/E tail of the spectrum begins has been determined, as well as the neutron temperature at the exit of a channel through the concrete shields.

6428
MEASUREMENT OF THERMAL NEUTRON ABSORPTION BY PILE OSCILLATION. P. Benoist, L. Kowarski, and F. Netter. J. phys. radium 12, 584-9(1951) May. (In French)

The method, as used at Châtillon, of measuring the absorption cross section of a substance by periodically inserting and removing it from the pile while following the corresponding oscillation in pile energy level is described. A graphite plug in a certain geometrical relation to the sample reflects neutrons into the center of the pile in opposite phase to the absorption, thus increasing the measurable amplitude range. The following cross sections in barns for thermal-neutron absorption, corrected for above thermal neutrons, have been measured: B, 710; Al, 0.219 ± 0.006; La, 8.35 ± 0.10; and Y, 1.25 ± 0.20.

6429
CALCULATION OF THE CRITICALITY OF A CYLINDRICAL PILE WITH REFLECTOR. J. Yvon. J. phys. radium 12, 573-9(1951) May. (In French)

The Laplacian of a reactor consisting of a multiplying cylinder sunk to its upper edge in graphite is calculated in detail by a perturbation method. The case of a thin, moderately absorbing wall inserted between the multiplying region and the reflector is also treated.

6430
DIMENSIONS OF THE CHATILLON PILE. L. Kowarski. J. phys. radium. 12, 751-5(1951) July-Aug.-Sept. (In French)

The components of the heavy water pile at Châtillon are described, dimensions are given, and starting, operation, criticality conditions, and power level are discussed. This is recently declassified information.

NUCLEAR TRANSFORMATION

6431
Rice Inst.
MAGNETIC ANALYSIS OF THE CHARGED PARTICLE GROUPS PRODUCED BY THE BOMBARDMENT OF CARBON, BERYLLIUM, AND OXYGEN WITH DEUTERONS (thesis); by Ernest D. Klema. Sept. 1950. 45p. (NP-3369)

The deuteron beam from the Rice Institute Van de Graaff generator was allowed to impinge at 45° on a Be target located in the center of a 15,000-gauss annular magnet. During the course of the experiment a carbon deposit and an oxide coating were built up on the target. Energies of the protons and α particles emitted from the target and focused at 180° by the magnetic field were determined from knowledge of the field strength and energy of the incident beam. The following Q values in Mev were found: $C^{12}(d,p)C^{13}$, 2.732 ± 0.006; $Be^{9}(d,p)Be^{10}$, 4.591 ± 0.008; $O^{16}(d,p)O^{17}$, 1.919 ± 0.008; $Be^{9}(d,\alpha)Li^{7}$ ground state, 7.191 ± 0.024, and excited state, 6.705 ± 0.022. From these values the masses of C^{13}, Be^{10}, and O^{17} were calculated to be 13.007555, 10.016756, and 17.004528, respectively. The $n^1 - H^1$ difference is 0.789 ± 0.008 Mev, and the first excited state in Li^7 is 486 kev.

6432
NEUTRON CAPTURE γ RAYS FROM LEAD AND BISMUTH. B. B. Kinsey, G. A. Bartholomew, and W. H. Walker. Phys. Rev. 82, 380-8(1951) May 1.

Only two strong γ rays have been detected with a pair spectrometer during the irradiation of Pb with thermal neutrons. The weaker of the two is due to capture of Pb^{206} and has an energy of 6.734 ± 0.008 Mev, and the stronger is due to capture in Pb^{207} and has an energy of 7.380 ± 0.008 Mev. Apart from a very weak γ ray with an energy of 6.90 ± 0.05 Mev, no other radiation has been detected. Bi produces a γ ray with an energy of 4.170 ± 0.015 Mev. The breadth of the coincidence peak is about 70 kev greater than would be expected for a homogeneous radiation. The γ rays revealed by the coincidence spectra of Pb and Bi have intensities of about 1 quantum/capture. The binding energies of Pb^{210} and Pb^{208} are discussed.

6433
MAGNETIC ANALYSIS OF α-PARTICLE GROUPS FROM (d,α) REACTIONS. A. Ashmore and J. F. Raffle. Proc. Phys. Soc. (London) 64A, 754-6(1951) Aug. (Letter to the editor)

A heavy-particle magnetic focusing spectrometer has been used to measure the energy spectrum of α particles emitted from $C^{12}(d,\alpha)B^{10}$ and $O^{16}(d,\alpha)N^{14}$ reactions. The α-particle spectra observed from thin deposits of C and ZnO are plotted.

6434
THE REACTION $^{13}C(\alpha,n)^{16}O$. G. A. Jones and D. H. Wilkinson. Proc. Phys. Soc. (London) 64A, 756(1951) Aug. (Letter to the editor)

Note is made of the observation of the reaction $C^{13}(\alpha,n)O^{16}$ from the bombardment of C^{13} with 1.05-Mev α particles. The energy of the neutrons from C^{13} was found to be 2.68 ± 0.15 Mev.

6435
ANGULAR DISTRIBUTIONS OF THE TWO LONG-RANGE NEUTRON GROUPS OF THE REACTION $^{16}O(d,n)^{17}F$. F. A. El-Bedewi, R. Middleton, and C. T. Tai. Proc. Phys. Soc. (London) 64A, 756-7(1951) Aug.

The angular distributions of the two long-range neutron groups from the reaction $O^{16}(d,n)F^{17}$ have been investigated using the photographic-plate technique. A lead-peroxide target was bombarded by the 8-Mev deuteron beam of the Liverpool 37-in. cyclotron. From measurements on the plates ranging from angles of -5 to 55° with respect to the incident deuteron direction, two long-range neutron groups were observed corresponding to the ground state and a level of the residual nucleus, F^{17}, at 0.53 ± 0.06 Mev. The Q-value for this reaction was found to be -1.51 ± 0.05 Mev, and from this the mass of F^{17} was calculated to be 17.007398 ± 0.00005 amu.

6436
NUCLEAR EXCITATION BY ELECTRIC INTERACTION WITH CHARGED PARTICLES. R. Huby and H. C. Newns. Proc. Phys. Soc. (London) 64A, 619-32(1951) July.

Inelastic scattering of charged particles can take place through the electrostatic interaction between the particles and the nucleus. Expressions for the total cross section of the process have been derived using several methods and are found to be in close agreement. The angular distributions are less reliable. Questions for more practical interest are discussed and conditions given for the best observation of the effect. The total cross sections are not negligible and certain experimental results can be explained. Inelastic nuclear scattering has been extensively used hitherto to obtain the positions of nuclear energy levels. It is suggested that more information about nuclear states might be provided by experiments exploiting the electrostatic interaction. (auth)

6437
COULOMB FUNCTIONS FOR REACTIONS OF PROTONS AND ALPHA-PARTICLES WITH THE LIGHTER NUCLEI. I. Bloch, M. H. Hull, Jr., A..A. Broyles, W. G. Bouricius, B. E. Freeman, and G. Breit. Revs. Modern Phys. 23, 147-82(1951) Apr.

New tables of coulomb functions are presented along with an introduction to their use. The ranges of parameters covered by the tabulations are those required for the calculation of reactions of protons, deuterons, and alpha particles with the lighter nuclei, from hydrogen to oxygen, in the energy range of a few Mev. For alpha particles the tables suffice for treatment of reactions up to about 10 Mev for Z = 9 (F) and 5 Mev for Z = 2 (He), while for protons the energy range covered is about 4 times that for alpha particles. An indication of the principal applications of coulomb functions is given. (auth)

6438
THE NUCLIDE P^{33} AND THE P^{32} SPECTRUM. Raymond K. Sheline, Richard B. Holtzman, and Chang-Yun Fan. Phys. Rev. 83, 919-23(1951) Sept. 1.

P^{33} has been produced by the bombardment of sulfur, sodium sulfide, and lithium chloride with the 48-Mev gamma-ray spectrum of the University of Chicago betatron. The reactions involved are $S^{34}(\gamma,p)P^{33}$, $Cl^{35}(\gamma,2p)P^{33}$, and $Cl^{37}(\gamma,\alpha)P^{33}$. The P^{33} activity has a 25 ± 2 day half life with a 0.27 ± 0.02-Mev negative beta ray. There is less than 1 (0.5-Mev) gamma for every 15 betas. The activity was observed in the presence of P^{32}, and its ratio to the P^{32} activity did not change with chemical purification. Beta-ray spectra of the weak component observed in Oak Ridge carrier-free P^{32} indicate that this weak activity is P^{33} produced by the reaction $S^{33}(n,p)P^{33}$. The cross section for pile neutrons for this reaction is approximately 0.029 barn. The Fermi plot of the beta-ray spectrum is straight with a log *ft* value of 5.2. A decay scheme for P^{33} is proposed. (auth)

6439
THE REACTIONS OF $He^3 + He^3$. W. M. Good, W. E. Kunz, and C. D. Moak. Phys. Rev. 83, 845-6(1951) Aug. 15. (Letter to the editor)

Preliminary investigation was conducted to determine the reaction when He^3 is captured by He^3. A beam of He^3 was directed against a 5-mil Al foil and thus against the He^3 accumulated thereon. Behind the foil was located a proton counter. The protons per energy interval are plotted against proton energy. The graph shows the maximum observed proton energy agreeing closely with that expected from the three-body breakup $He^3 + He^3 \rightarrow He^4 + H^1 + H^1 +$ 12.82 Mev.

6440
ANGULAR DISTRIBUTIONS FOR (d,p) AND (d,n) REACTIONS IN LIGHT NUCLEI. S. T. Butler and J. L. Symonds. Phys. Rev. 83, 858(1951) Aug. 15. (Letter to the editor)

The experimental angular distribution for the reactions $T(d,n)He^4$ and $He^3(d,p)He^4$ is explained by means of the stripping process. A comparison between the theoretical and experimental angular distributions for the $T(d,n)He^4$ reaction for an incident deuteron energy of about 10.5 Mev (lab) is given. Good agreement exists from 0 to 100° (c.m.s.); beyond 100° the two curves diverge.

6441
ON THE DECAY OF I^{131}. Sigvard Thulin. Phys. Rev. 83, 860-1(1951) Aug. 15. (Letter to the editor)

The position of the levels associated with the high-energy γ rays in the decay of I^{131} were investigated. The upper limits of the two β components were found to be 607 and 255 ± 30 kev and the high-energy γ rays were measured as 638.0 ± 0.6 and 723.9 ± 0.7 kev. Coincidences were found between the K-conversion line of the 80-kev γ ray and each of the above β components.

6442
γ RAYS IN THE REACTION $Be^9(\alpha,n)C^{12}$. K. P. Artemov and N. A. Vlasov. Doklady Akad. Nauk S.S.S.R. 77, 225-7(1951). (In Russian)

Using a γ-ray spectrometer proposed by Dzhelepov (Doklady Akad. Nauk S.S.S.R. 23, 25(1939)) which records internal-conversion pairs in a magnetic field, the authors have examined a part of the γ emission accompanying the reaction $Be^9(\alpha,n)C^{12}$ and corresponding to transitions from excited levels of C^{12}. The γ rays were produced by bombarding a thick Be layer (10 mg/cm²) with 5.3-Mev α particles. The spectrum obtained had a maximum at 4.37 ± 0.07 Mev. No other maxima were found in the interval 2 to 8 Mev.

6443
CORRELATION PHENOMENA AND CAPTURE OF POLARIZED NEUTRONS. Otto Halpern. Phys. Rev. 83, 669(1951) Aug. 1. (Letter to the editor)

A brief qualitative discussion is given of the transfer of polarization in the case where capture of a polarized neutron is followed by a two-step (or more) transition to the final state. Depending upon the angular momentum of the original nucleus, the initial state of the final nucleus is totally or partially polarized.

6444
POLARIZATION OF GAMMA-RADIATION FOLLOWING CAPTURE OF POLARIZED NEUTRONS. L. C. Biedenharn, M. E. Rose, and G. B. Arfken. Phys. Rev. 83, 683(1951) Aug. 1. (Letter to the editor)

Consideration is given to the anisotropy properties of γ rays following capture of polarized neutrons. It is shown theoretically that with ordinary Compton scattering, pair formation, or photoelectric processes as detection devices (all of which measure linear polarization) no anisotropy will

occur, because the detection processes do not distinguish between right and left circular polarization or between these and unpolarized radiation. The desired circular polarization detector can be obtained by using magnetized iron as a Compton scatterer. Then an azimuthal anisotropy in the Compton scattered intensity will arise because the intensities of the right and left circularly polarized components of the radiation are different. The neutron capture leading to an even-even compound nucleus and a transition leading to the ground state is discussed as an example.

6445
ON THE GOLDBERGER MODEL FOR THE INTERACTION OF HIGH ENERGY NUCLEONS WITH HEAVY NUCLEI. G. Bernardini, E. T. Booth, and S. J. Lindenbaum. Phys. Rev. 83, 669-71(1951) Aug. 1. (Letter to the editor)

The nuclear interactions induced by 350- to 400-Mev protons in β-sensitive nuclear emulsions are compared to predictions according to Goldberger's model (Phys. Rev. 74, 1269(1948)). A Goldberger model work diagram is shown, and results of experiments and calculations are tabulated and plotted. It is concluded that results of the experimental 400-Mev proton interactions can be satisfactorily explained by the model.

6446
EXCITED STATES OF Si^{29} FROM AN INVESTIGATION OF THE $P^{31}(d,\alpha)Si^{29}$ AND $Si^{28}(d,p)Si^{29}$ REACTIONS. P. M. Endt, D. M. Van Patter, W. W. Buechner, and A. Sperduto. Phys. Rev. 83, 491-4(1951) Aug. 1.

The alpha-particle groups from a thin target of zinc phosphate bombarded by 1.81-Mev deuterons have been studied with a high resolution magnetic spectrograph. Eight of the alpha groups observed have been assigned to the previously unreported $P^{31}(d,\alpha)Si^{29}$ reaction, corresponding to the ground state and seven excited states of Si^{29} in a region of excitation of 0 to 5 Mev.

From a similar investigation of the proton groups from thin targets of silicon dioxide bombarded by 1.81-Mev deuterons, 10 $Si^{28}(d,p)Si^{29}$ proton groups were observed, corresponding to the ground state and 9 excited states of Si^{29}. The positions of the excited states found from the $P^{31}(d,\alpha)Si^{29}$ reaction agreed within the experimental error with those obtained from the $Si^{28}(d,p)Si^{29}$ reaction. The excited states observed in Si^{29} are at 1.282, 2.038, 2.436, 3.073, 3.623, 4.078, 4.840, 4.897, and 4.934 Mev. (auth)

6447
(d,n) REACTIONS WITH 15-MEV DEUTERONS. PART I. ANGULAR DISTRIBUTIONS. C. E. Falk. Phys. Rev. 83, 499-504(1951) Aug. 1.

Nine elements are bombarded with 15-Mev deuterons from a cyclotron. The resulting angular distributions of 9.25- to 13.1-Mev neutrons are measured by means of a four-proportional counter telescope and also by threshold detectors. It is observed that all the measured angular distributions are peaked in the forward direction, some showing a peak at 0° and others peaks at 10° to 15° with respect to the deuteron beam. Different methods of production of neutrons from (d,n) reactions are discussed, and it is shown that most of the observed neutrons are produced by a stripping process. (auth)

6448
THE ANGULAR DISTRIBUTION IN THE PHOTODISINTEGRATION OF THE DEUTERON AT LOW ENERGIES. G. R. Bishop, L. E. Beghian, and H. Halban. Phys. Rev. 83, 1052 3(1951) Sept. 1. (Letter to the editor)

The angular distribution of the protons and neutrons produced in the photodisintegration of the deuteron has been determined by making use of the fact that the energy of the photonucleons depends on the angle, relative to the disintegrating γ ray, at which they are ejected.

A long cylindrical proportional counter was filled with D_2, and the γ-ray source was placed in the middle. The output pulses were examined with a kicksorter of the Wilkinson type. The ratios of photomagnetic cross section to photoelectric cross section (σ_m/σ_e) obtained were 0.247 ± 0.007 with Na^{24} as source, 0.360 ± 0.008 with ThC'' (Tl^{208}), and 0.600 ± 0.02 with Ga^{72}.

6449
A COMPARISON OF SEVERAL NUCLEAR ABSOLUTE VOLTAGE DETERMINATIONS. William J. Sturm and Virgil Johnson. Phys. Rev. 83, 542-7(1951) Aug. 1.

An evaluation of the consistency between the absolute voltage determination of the threshold energy of the $Li^7(p,n)Be^7$ reaction as measured by Herb, Snowdon, and Sala and earlier independent absolute alpha-particle energy measurements has been made. The experimental comparison was affected by employing the natural alpha-particles from polonium and radium C', the energy of which has been measured absolutely by several authors using magnetic deflection methods. In this experiment the alpha-particles from these substances have been electrostatically deflected in the 90° cylindrical electrostatic analyzer at the University of Wisconsin. Alpha-particle line measurements were analyzed by numerical integration of resolution and source functions and in themselves contributed negligibly to the uncertainties of the comparison. The resulting alpha-particle energies, evaluated by comparison with the energy of the $Li^7(p,n)Be^7$ threshold, agree with earlier measurements, and indicate that within the limits of accuracy of the experiments, all determinations give identical results. (auth)

6450
PHOTODISINTEGRATION OF THE ALPHA-PARTICLE AND THE INVERSE PROCESSES. B. H. Flowers and F. Mandl. (Proc. Roy. Soc. (London) 206A, 131-44(1951) Mar. 22.

The partial cross sections for photodisintegration of the α particle are calculated in the usual first-order perturbation theory approximation, utilizing the symmetry properties of the wave functions of the α particle and of the various product nuclei. From these results the cross sections for radiative capture of protons by ^3H, neutrons by ^3He, and deuterons by deuterons, can be deduced. It is found that (a) the yield of gamma rays from the $^3H(p,\gamma)^4He$ reaction should increase with bombarding energy up to several Mev; (b) the radiative capture cross section of ^3He for thermal neutrons should be negligible; and (c) the radiative cross section for the D + D reaction should be smaller than that for the T + P reaction at corresponding energies by a factor of about 10^{-3}. Conclusion (a) is discussed in the light of recent experiments at Los Alamos, which purport to establish the existence of an excited state of the alpha particle. (auth)

PARTICLE ACCELERATORS

6451
Brookhaven National Lab.
ACCELERATOR, p.26-30 of QUARTERLY PROGRESS REPORT; APRIL 1–JUNE 30, 1951. Issued Aug. 1951. 5p. (BNL-117(p.26-30))

Brief statements are presented of construction status and modifications in the cosmotron power system, injection, magnet, winding, vacuum system, etc.

6452
MULTIPLE TRAVERSAL OF CYCLOTRON TARGETS: AN EXTENSION TO THE THEORY. J. M. Cassels, J. M. Dickson, and J. Howlett. Proc. Phys. Soc. (London) 64B, 719 (1951) Aug. 1. (Letter to the editor)

In an earlier communication (Proc. Phys. Soc. (London) 64B, 590(1951)) the effective thickness, T, of the cyclotron

target, measured in radiation length units, was calculated as a function of $\lambda = w^2nd^2/4tr_0^2$, where t is the actual thickness of the target, in radiation length units, and w, n, d, and r_0 are parameters determined by the operating conditions of the cyclotron. The discussion was restricted to values of $\lambda \leq 4$, so that the theory could not be applied to very thin targets. Fourier transform techniques have been applied to the earlier paper and the asymptotic variation of T when λ is large has been obtained. Figures derived from this solution show that accurate results can now be obtained for $\lambda \geq 4$.

6453
MULTIPLE TRAVERSAL OF CYCLOTRON TARGETS. J. M. Dickson. Proc. Phys. Soc. (London) 64B, 615-16 (1951) July. (Letter to the editor)

Several carbon targets were irradiated in the Harwell cyclotron internal proton beam at 150 Mev in an attempt to verify the theoretical relation between the number of target traversals and the target thickness (Cassels et al., Proc. Phys. Soc. (London) 64B, 590(1951)). Good agreement is shown graphically between the experimental and predicted values.

6454
A DEE BIASING SYSTEM FOR A FREQUENCY MODULATED CYCLOTRON. L. L. Davenport, L. Lavetelli, R. A. Mack, A. J. Pote, and N. F. Ramsey. Rev. Sci. Instruments 22, 601-4(1951) Aug.

The requirements that must be met by a satisfactory dee-biasing system are outlined, and the chief problems are discussed. A successful and simple means of meeting these requirements is described in which a d-c bias potential of several thousand volts is applied to the dee with respect to the grounded metal surfaces within the cyclotron vacuum tank. Condensers were inserted between the dee and ground at the end of each dee stem in order to prevent a d-c path of very low resistance.

6455
AN AIR-CORED SYNCHRO-CYCLOTRON FOR 400-MEV PROTONS. L. Riddiford. Proc. Phys. Soc. (London) 64B, 218-24(1951) Mar.

It is considered that the most reasonable proposition for accelerating protons to very high energies, using an instrument which employs a magnetic field produced by an air-cored coil, is to operate the machine as a synchro-cyclotron. An investigation of the energies available from such accelerators for given amounts of stored magnetic-field energy is carried out on the basis that the limit is set by the mechanical forces exerted on the coil. It is shown that the power requirements are comparable with those of large iron-cored accelerators at present under construction. In a machine with a useful orbit of radius 11.8 cm, it is possible to provide a field of 2.7×10^5 gauss over the circle enclosed by that orbit, so that protons would be accelerated to an energy of 400 Mev. (auth)

RADIATION ABSORPTION AND SCATTERING

6456
Radiation Lab., Univ. of Calif.
DISTRIBUTION OF A FINITE PARTICLE BEAM AFTER BEING MULTIPLY SCATTERED BY A THIN FOIL; by Val J. Ashby. Aug. 8, 1951. 10p. (UCRL-1414)

A charged-particle beam of circular cross section, uniform density, negligible angular divergence, and homogeneous energy is considered to impinge upon a thin foil where it undergoes multiple scattering. The fraction of the beam which is then expected to pass through a given circular aperture concentric with the initial beam axis is calculated. The integration is outlined, and numerical results for several values of beam and aperture radii are presented graphically. (auth)

6457
Radiation Lab., Univ. of Calif.
THE DIFFERENTIAL CROSS SECTION FOR THE SCATTERING OF 9.5-MEV PROTONS FROM HELIUM (thesis); by Thomas Milton Putnam, Jr. Aug. 22, 1951. 108p. (UCRL-1447)

The scattering of protons from a "thin" He gas target at an incident proton energy of 9.5 Mev has been investigated. The 20-Mev molecular-hydrogen beam from the 60-in. cyclotron was used as the source of protons. The scattering chamber, or multiplate camera (Allred et al., Rev. Sci. Instruments 22, 191(1951)), is so constructed that every 2.5° angle from 10° to 172.5° can be monitored by means of a 1 in. by 3 in. nuclear emulsion plate. Measured cross sections as a function of angle are tabulated. Results are compared graphically with earlier work at lower energies. The 9.5- and 3.58-Mev curves (Freier et al., Phys. Rev. 75, 1345(1949)) are similar. The minima occur at approximately the same angle in the center-of-mass system, and the two curves are nearly parallel at angles greater than about 60°. The Coulomb scattering becomes significant at a lower scattering angle for the higher-energy case. No excited state of Li^5 was observed in careful range analyses of the plates for possible lower-energy proton peaks.

6458
COHERENT SCATTERING PROCESSES ARISING FROM QUANTUM CORRELATIONS. Louis Goldstein. Phys. Rev. 83, 289-98(1951) July 15.

Quantum statistical forces in ideal symmetric and antisymmetric fluids establish an ordered arrangement of their fluid molecules in space. The coherent scattering properties of these fluids resulting from this spatial order are studied in this paper. (auth)

6459
SCATTERING OF 3.27-MEV (d,d) NEUTRONS BY DEUTERONS IN THE WILSON CHAMBER. I. Hamonda, J. Halter, and P. Scherrer. Helv. Phys. Acta 24, 217-34(1951) July 10. (In German)

The angular distribution of 3.27-Mev (d,d) neutrons scattered by deuterons was investigated in the cloud chamber. To eliminate the disturbing effects of the neutrons scattered into the chamber from the surrounding material and to account for corrections due to the geometry of the apparatus, the angular distribution of neutron-proton scattering was also investigated with the same neutron source and under the same geometrical conditions. Assuming that the (n,p) distribution is isotropic, one obtains a correction factor for the disturbing effects, which is just the deviation from isotropy of the measured distribution. In two separate runs of photographs under different geometrical conditions 5000 proton recoils and 10,000 deuteron recoils were investigated. The two independently measured (n,d) angular distributions were found to agree well within the limits of statistical fluctuation. Our data show a pronounced maximum at neutron scattering angle of 180° which is about three times the minimum at 90° in center of mass system. An extrapolation to 0° gives a maximum which is about 1.5 times the minimum.

6460
A METHOD OF DETERMINING THE WAVELENGTH DISTRIBUTION OF THE X RADIATION AT A POINT IN A SCATTERING MEDIUM. J. R. Greening. Brit. J. Radiology 24, 204-6(1951) Apr.

An experimental method of determining the wavelength distribution of x radiation at a point within a block of irradiated material is described. The method consists in measuring the absorption of the radiation in spherical shells of absorbing material placed around a spherical

ionization chamber. The absorption curve is converted to that which would have been obtained had it been possible to use flat filters, and this curve is analyzed by a method described elsewhere (Proc. Phys. Soc. (London) 63A, 1227(1950)) to give the spectral distribution of the radiation. Illustrative examples are given of curves obtained.

6461
RANGES OF Po α RAYS IN CRYSTALS OF CERTAIN ALKALI HALOGENIDES. Leopold Wieninger. Helv. Phys. Acta 4, 355-9(1951) May. (In German)

Ranges of α particles from Po in NaCl, KCl, KBr, and KI crystals were determined by measuring the decolorizing action of the rays. The ranges in the four salts in the order listed are 29.16, 33.05, 30.62, and 30.13μ, with a probable error < ±2%. Using these values, the "molecular" stopping power of the compounds relative to air, and the atomic stopping power of the elements were calculated. (auth)

6462
ON THE BACKSCATTERING OF ELECTRONS. Georges Charpak and Francis Suzor. Compt. rend. 232, 2308-9(1951) June 18. (In French)

The authors' hypothesis that β particles are excited electrons and should, therefore, show a scattering behavior different from electrons as the energy of excitation is lost by collision has found no justification in the present experiment. The absorption in Al of Tc^{99m} and In^{115m} electrons backscattered from an Al foil did not differ significantly from the absorption of β particles under the same conditions.

6463
ASYMPTOTIC FORMULA FOR STOPPING POWER OF K-ELECTRONS. M. C. Walske and H. A. Bethe. Phys. Rev. 83, 457-8(1951) July 15. (Letter to the editor)

In Brown's asymptotic formula for the stopping number of K electrons (Phys. Rev. 79, 297(1950)) it was assumed that the energy given to the atomic electron is a very small fraction ($\leq 4m/M$, where m = electron mass and M = mass of incident particle) of the incident particle's energy. For bound electrons this is not true, and a correction is made to Brown's formula for the total stopping number of hydrogen, and is applied to his formula for other elements.

6464
ON AN ANOMALY IN THE SCATTERING OF β RAYS. II. Tosiko Yuasa and Pierre Radvanyi. Compt. rend. 232, 1417-19(1951) Apr. 9. (In French)

The anomalous decrease in scattering of P^{32} π particles at large angles observed in a previous study (Compt. rend. 232, 1348-50(1951)) has been confirmed by using a Au-foil scatterer and by inserting polystyrene sheets between source and foil.

6465
ON AN ANOMALY CONCERNING THE SCATTERING OF β RAYS IN MATTER. I. Tosiko Yuasa. Compt. rend. 232, 1348-50(1951) Apr. 2. (In French)

As the distance in an air- or air-He-filled cloud chamber between a P^{32} source of β particles and a 0.3-mg/cm^2 foil of Al was increased the per cent of particles scattered by the foil through more than 5° or more than 10° decreased, whereas the scattering of internal-conversion electrons from In^{115m} remained unchanged. It is concluded that β radiation becomes modified by traversing a small thickness of matter.

6466
THE ANNIHILATION OF POSITRONS. IV. ONE-QUANTUM AND TWO-QUANTA ANNIHILATION IN MOTION. Süreyya Meric. Rev. faculté sci. univ. Istanbul 15A, 179-204(1950) July.

The separation of positrons from the nuclear γ rays of Cu^{64} was achieved by the trochoidal method. The apparatus and setup of the separation process and experiment on the annihilation radiation are described at length. The author states that (1) the results prove the existence of one-quantum annihilation radiation; (2) it is produced only in a heavy annihilating medium in sufficient amount to be observed; (3) the existence of two-quanta annihilation radiation in motion is established; (4) the ratio of the intensity of single-quantum radiation to that of the two-quanta radiation in motion agrees with the theoretical value within a factor of 2; (5) the effect of any nuclear γ radiation ascribed to the source is quite negligible.

6467
RESONANT SCATTERING OF SLOW NEUTRONS BY CADMIUM. B. N. Brockhouse, D. G. Hurst, and M. Bloom. Phys. Rev. 83, 840-1(1951) Aug. 15. (Letter to the editor)

Scattering of slow neutrons by Cd has been measured over a range of neutron energy, 0.02 to 0.4 ev, which includes the resonance at 0.176 ev. The ratio of scattering to absorption cross sections in Cd was plotted against neutron energy. The experimental results is in excellent agreement with the predicted ratio by the Breit-Wigner formula except near resonance energy.

6468
RESONANT SCATTERING IN SAMARIUM AND GADOLINIUM. B. N. Brockhouse and D. G. Hurst. Phys. Rev. 83, 841(1951) Aug. 15. (Letter to the editor)

Scattering of low-energy neutrons by Sm and Gd has been measured over the energy range 0.02 to 0.150 ev including the resonance energies. The ratio of scattering to adsorption cross section in Sm was plotted against neutron energy. The shapes of the experimental and theoretical curves are closely alike. Comparison of curves suggests that the spin of Sm^{149} is high ($i > 3/2$). A spin as high as 9/2 is within experimental error. The measured values for Gd were about 20% too high due to contamination. Even so, the experimental curves were about 15% below the lowest theoretical. Any correction for contamination increased the discrepancy. This disagreement shows that the low energy adsorption in Gd cannot be described by a one-level formula.

6469
THE MULTIPLE SCATTERING OF μ-MESONS. A. V. Crewe. Proc. Phys. Soc (London) 64A, 660-1(1951) July. (Letter to the editor)

In view of the importance of multiple scattering as a means of measuring the energy of fast particles in nuclear emulsions, an experiment has been performed to check the theoretical angular distribution using particles of known energy. The scattering of μ mesons in Pb was observed in a cloud chamber triggered by coincidence counters. The mean scattering angle, corrected for geometry of the apparatus, was found to be 3.68 ± 0.4 deg, 65% of the theoretical value according to the Born approximation. This confirms the conclusion of Parzen (Phys. Rev. 80, 261 (1950)) that the Born approximation is not valid for heavy elements and is in agreement with previous work on the scattering of electrons and mesons.

6470
SCATTERING OF SLOW NEUTRONS BY AN ISOTROPIC HARMONIC OSCILLATOR. Albert Messiah. J. phys. radium 12, 670-2(1951) June. (In French)

The behavior of the total scattering cross section of a slow neutron by an isotropic harmonic oscillator in the ground state when the energy E of the incident neutron is high with respect to the separation of the vibration levels is studied theoretically for the general case where the mass of the oscillator differs from the mass of a neutron. Con-

trary to the case where the two masses are equal, the fluctuations vanish from the term in 1/E of the asymptotic development obtained.

6471

MULTIPLE COULOMB SCATTERING OF HIGH ENERGY PROTONS IN PHOTOGRAPHIC EMULSIONS. Martin J. Berger, J. J. Lord, and Marcel Schein. Phys. Rev. 83, 850(1951) Aug. 15. (Letter to the editor)

Measurements of multiple coulomb scattering of high-energy protons in photographic emulsions were made in order to determine a precise value for the universal "scattering constant." Ilford G5 plates were dropped through the proton beam of the Berkeley cyclotron. Measurement of 150 tracks gave 24.1 ± 0.8 for the scattering constant K_{100} (100-μ cell length).

6472

THE EFFECT OF SCATTERING ON ANGULAR CORRELATION MEASUREMENTS. Sherman Frankel. Phys. Rev. 83, 673(1951) Aug. 1. (Letter to the editor)

A comparatively simple method is outlined for correcting measurements of angular correlations (involving electrons) for multiple scattering in the source and for the finite solid angle of the detectors. The result is extended to include the correlation between the first and the nth events provided the correlation between the (k + 1)th and kth events is independent of the previous events.

6473

THE APPLICATION OF VARIATIONAL METHODS TO ATOMIC SCATTERING PROBLEMS. I. THE ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. H. S. W. Massey and B. L. Moiseiwitsch. Proc. Roy. Soc. (London) 205A, 483-96(1951) Mar. 7.

The variational methods proposed by Hulthèn and by Kohn have been applied to the investigations of the elastic scattering of slow electrons by hydrogen atoms. Allowance has been made for both exchange and polarization effects in determining the zero-order phase shift. By comparison with results obtained by direct numerical integrations of the differential equations determining the scattering when the total wave function is assumed to have a separable form, it seems likely that both variational methods, which yield very nearly the same results, give satisfactory results except in certain sensitive cases, even when simple trial functions are employed. It is found that the inclusion of polarization (in the form of a nonseparable wave function) is less important when exchange is included than when it is not. Reasons why this would be expected are given. Detailed results are obtained for electrons with energies up to 50 ev. (auth)

6474

THE RANGE AND STRAGGLING OF PROTONS BETWEEN 35 AND 120 MEV. N. Bloembergen and P. J. van Heerden. Phys. Rev. 83, 561-6(1951) Aug. 1.

The range of protons in aluminum, copper, and lead has been determined with a photographic method, using the internal beam of the 95-in. synchrocyclotron of Harvard University. The method allows the simultaneous determination of the range, straggling, and the energy distribution of the protons in the internal beam. The latter was shown to have a half width of 12 Mev. The experimental results for the range show slight, but significant, deviations from tabulated values. Results for the straggling agree well with theory, if the effect of multiple scattering in the absorber is taken into account. (auth)

6475

Z DEPENDENCE AND ANGULAR DISTRIBUTION OF BREMSSTRAHLUNG FROM 17-MEV ELECTRONS. L. H. Lanzl and A. O. Hanson. Phys. Rev. 83, 959-74(1951) Sept. 1.

The relative bremsstrahlung cross section for the upper portion of the spectrum as a function of Z, for 17-Mev electrons from a 22-Mev betatron, has been measured. The radiation was detected by means of the $Cu^{63}(\gamma,n)$ induced activity, which has a 10.9-Mev threshold. The effect of atomic screening is small for the quantum energies to which this detector responds, but was taken into account. The results are in agreement with the Bethe-Heitler theory for electron-nuclear interactions within 1 %. Electron-electron interactions give 0.75 times the intensity for electron-proton interactions, as measured with a copper detector.

The total cross section for radiative energy loss of electrons has been measured with an ionization chamber. The experimental Z dependence of the relative cross section indicates that the yield from gold for a given $N(Z^2 + Z)$ is somewhat less than that from low Z elements.

The intrinsic angular distribution of bremsstrahlung, produced in a small amount of cellophane and air, was measured by film and ion chamber, and was found to fit a $1/[1 + (E\theta/\mu)^2]^2$ distribution. The angular distribution was measured with three detectors, for one Be and several Au targets. The results are in agreement with calculations in which the above intrinsic distribution and Molière's multiple scattering theory are used.

6476

ON LOW ENERGY X-RAY ABSORPTION BY NUCLEI. Robert H. McFarland. Phys. Rev. 83, 666(1951) Aug. 1. (Letter to the editor)

A series of experiments have been performed to determine the possibility of resonance absorption of low-energy x rays by nuclei. Measurements of absorption of x rays by Ni, Cu, Fe, Zn, and Ca using electronic recording equipment failed to reveal any excited energy levels under 100 kv. The region from 80 to 100 kv was carefully explored using Ag as absorber, but neither the isomeric transition of 0.087 in Ag^{109} nor the 0.093-Mev transition in Ag^{107} was evoked by the low-energy x rays. Rb^{87} and Sr^{87} were surveyed in an attempt to excite the γ rays of 0.034, 0.053, and 0.082 Mev associated with Rb^{87} decay. No absorption was observed which could be attributed to resonance transitions within the nucleus. For the cases cited the cross sections for nuclear resonance absorption are less than 50 barns.

6477

RANGE OF HIGH ENERGY ELECTRONS IN ALUMINUM. H. E. Johns, J. R. Cunningham, and L. Katz. Phys. Rev. 83, 952-4(1951) Sept. 1.

An electron beam has been extracted from the 25-Mev betatron of the Physics Department of the University of Saskatchewan by using a magnetic peeler similar in design to that developed at the University of Illinois. The high energy electron beam was analyzed by bending it through an angle of 90° with a magnetic field. The high energy electrons were passed in turn through a flat ionization chamber, the aluminum absorber and a second ionization chamber. By measuring the ratio of the two ionization currents for different thicknesses of the absorber, the range of the electrons was determined. The ranges of electrons having energies from 12 to 16 Mev were obtained in this way and found to be in agreement with an empirical formula. (auth)

6478

MEASUREMENT OF NUCLEAR POLARIZABILITIES BY NUCLEAR SCATTERING EXPERIMENTS. Norman F. Ramsey. Phys. Rev. 83, 659(1951) Aug. 1. (Letter to the editor)

Scattering experiments are suggested which should provide an independent means for measuring the polarizabilities of a number of different nuclei. The basic principle is that the elastic scattering of charged nuclei can be measured

under circumstances such that the scattering is almost exclusively electrical and elastic. Then if the nuclei are polarizable, i.e., if they can be distorted by the strong electric fields which arise in the scattering of charged nuclei, the change in the nuclear charge distribution associated with the distortion will modify the electrical scattering and give rise to a measurable departure from the Rutherford scattering law.

6479
MULTIPLE ELASTIC SCATTERING AND RADIATION DAMPING. H. Ekstein. Phys. Rev. 83, 721-9(1951) Aug. 15.

The problem of potential scattering by a number of similar scatterers is reformulated so that the potential is eliminated from the equations and replaced by a function which characterizes the scattering properties of the individual scatterer. The resulting equations can be used for the more general case where the single-scattering process is not describable by a potential, e.g., absorption or—to a certain extent—inelastic scattering. A solution of the equations by iteration is considered and compared with Born's approximation. As an application, the second approximation for the scattering of thermal neutron by a small crystal is calculated. (auth)

6480
NEUTRON-DEUTERON SCATTERING AMPLITUDES. E. O. Wollan, C. G. Shull, and W. C. Koehler. Phys. Rev. 83, 700-2(1951) Aug. 15.

The diffraction of neutrons from deuterium containing compounds gives the coherent scattering section of deuterium which can be used to determine the spin dependent scattering amplitudes. Studies have been made on a number of deuterium containing compounds but the results reported here are concerned primarily with recent measurements on NaD. X-ray measurements have been used in interpreting the thermal vibration effects in the crystal and use has been made of Na scattering cross-section data obtained from various sodium containing compounds. This experiment gives $\sigma_{coh} = 5.2 \pm 0.3$ barns. This value can be combined with the results of other deuterium cross-section measurements to give pairs of values for the individual quartet and doublet spin amplitudes for n-d scattering. Various experimental results bearing on this point are summarized. Recent theoretical work seems to have eliminated the ambiguity in the experiments with regard to which of two sets of values of the spin amplitudes is to be chosen. (auth)

6481
MEASUREMENT BY PILE MODULATION OF THE EFFECTIVE CROSS SECTIONS OF SEVERAL ELEMENTS FOR SLOW-NEUTRON ABSORPTION. Bertel Grimeland, Erik Hellstrand, and Francis Netter. Compt. rend. 232, 2089-91(1951) June 4. (In French)

The effective cross sections for pile neutrons of Li, Cl, V, Cr, Mn, Fe, Co, Ni, Hg, and Cu have been measured relative to boron by pile modulation. These cross sections are compared with those for thermal neutrons. With the exception of Hg, for which $\sigma_{pile} < \sigma_{th}$ because of resonance absorption, the agreement is excellent.

6482
OBSERVATIONS ON THE MULTIPLE SCATTERING OF IONIZING PARTICLES IN PHOTOGRAPHIC EMULSIONS. PART I. THE VALUE OF THE SCATTERING CONSTANT. K. Gottstein, M. G. K. Menon, J. H. Mulvey, C. O'Ceallaigh, and O. Rochat. Phil. Mag. 42, 708-21(1951) July.

The theories of multiple scattering of Williams, Molière, Snyder, and Scott are briefly surveyed. The results of five independent determinations of the scattering constant for G.5 nuclear research emulsions, details of which are to be presented in the following papers, are compared and discussed. The constant has been found to vary with cell-size and β in a manner which is in agreement with theory. The effect of rejecting large angles due to plural scattering is considered, and also those errors which arise from the presence of spurious scattering. (auth)

6483
ON RADIATIVE CORRECTIONS TO THE ANGULAR CORRELATION IN INTERNAL PAIR CREATION. R. H. Dalitz. Proc. Roy. Soc. (London) 206A, 521-38(1951) May 22.

A detailed discussion of the radiative corrections to internal pair creation is given, including the effect of all internal bremsstrahlung. Numerical results are presented for the 6·04-Mev zero-zero transition in O^{18}, for which the effects of the Coulomb field, of the nuclear structure, and of the non-Coulomb forces are shown to be negligible. The total correction amounts to a decrease of 0·7 % in the total pair emission, and varies quite slowly with the angle between the pair, except near $\theta = 0°$ (due to the interaction between the pair—the number of pairs with separation $< 10°$ is increased by 2·3%) and $\theta = 180°$ (an increase of 5% in pair emission due to pairs accompanied by a hard photon). (auth)

RADIATION EFFECTS

6484
Purdue Research Foundation
BASIC RADIATION DAMAGE STUDIES WITH CHARGED PARTICLES; FINAL TECHNICAL REPORT; JULY 1, 1950–JUNE 30, 1951. 23p. (AECU-1619)

Results of work during this period on effects of Po α radiation on thin Ge and PbS films, radiation damage on high polymers and natural rubber, electron- and x-ray-diffraction studies of diffuse reflections of Ge single crystals, structural changes caused by deuteron or α-particle bombardment in PbS crystals and thin films, Se, Na oxalate, and As_2O_3, development of pulse-heating equipment, and investigations of specific heat and thermal conductivity of Ge and Si semiconductors before and after irradiation are summarized and discussed.

6485
DETERIORATION OF ANTHRACENE UNDER α-PARTICLE IRRADIATION. J. B. Birks and F. A. Black. Proc. Phys. Soc. (London) 64A, 511-12(1951) May. (Letter to the editor)

The effect of intense α radiation on the scintillation efficiency of anthracene has been studied quantitatively. It was found that, allowing for the Po (source) decay, the irradiation caused no decrease in the number of scintillations from the crystal, but that their relative amplitude I/I_0 obtained from the mean pulse size decreased as $I/I_0 = 1/(1 + AN)$, where N is the total number of α particles/cm^2 striking the crystal, and $A = 10^{-11}$. The low fluorescent efficiency of anthracene under α-particle excitation is apparently attributable to local quenching by the molecules damaged by the incident α particle.

RADIOACTIVITY

6486
Brookhaven National Lab.
THE DECAY OF Rh^{106} (abstract); by David E. Alburger. [nd] 1p. (AECU-1623)

The report is reproduced here in its entirety.

Ru^{106}-Rh^{106} β rays with end points 3.53 ± 0.01 Mev (68%), 3.1 ± 0.1 Mev (11%), 2.44 ± 0.07 Mev (12%), and 2.0 ± 0.1 Mev (3%) have been observed using a lens spectrometer. γ rays are also present with energies of 0.513, 0.624, 0.87, 1.045, and 1.55 Mev and relative intensities of 1 : 0.53 : 0.03 : 0.08 0.025, respectively, as measured by photoelectric con-

version. There is evidence for a γ ray of 2.9 Mev. The 0.513- and 0.624-Mev lines are internally converted with K intensities of 7.5×10^{-4} and 2.3×10^{-4} relative to total β radiation. At 1.6% resolution the 0.513-Mev transition K and L conversion lines are separated and have a ratio of 7.8 ± 1. Using the recent analysis of K/L ratios by Goldhaber and Sunyar one can conclude that this transition is an electric quadrupole; from relative conversion intensity the 0.624-Mev line must also be E2. The results are consistent with β decay to states in Pd^{106} at zero, 0.513, 1.137, and 1.55 Mev. The 0.87- and possible 2.9-Mev γ rays and excess β rays are apparently associated with weakly excited higher states. From this scheme the K-conversion coefficients of the 0.513- and 0.624-Mev γ rays are $(3.5 \pm 1) \times 10^{-3}$ and $(2.1 \pm 1) \times 10^{-3}$, both consistent with E2. It is proposed that the spins of the ground and first three excited states of Pd^{106} are 0, 2, 0, and 2 and that the superposition of 0-2-0 and 2-2-0 cascades is sufficient to explain the known Rh^{106} γ-γ angular correlation. This is supported by unpublished work of J. Kraushaar.

6487

Argonne National Lab.

THRESHOLD VALUES OF INTERNAL CONVERSION COEFFICIENTS FOR THE K-SHELL. B. I. Spinrad and L. B. Keller. Aug. 1951. 1p. (AECU-1615; UAC-431)

The report is reproduced here in its entirety.

Recent computations of the internal conversion coefficients for the K shell have been reported for various Z and for k (γ-ray energy) greater than 0.3 to 0.5 electron masses (Rose, Goertzel, Spinrad, Harr, and Strong, Phys. Rev. 83, 79(1951); NSA 5-4853). The extrapolation of these results to lower energies is uncertain for two reasons: first, the mathematical formulation of the problem is of such complexity that no simple extrapolation rule can be used; second, the numbers are computed for unscreened wave functions. In an attempt to resolve the mathematical difficulties, computations have been made on the threshold values of the conversion coefficients. These computations were performed by taking the limiting values of the formulas of the reference above as p, the electron momentum, approaches zero positively. Under these conditions, many simplifications arise, and it is possible to compute the results on a desk machine. The results are tabulated below. The notation is that of the reference above. Since screening has been ignored, the threshold energies for which these results were computed were those obtained from the relativistic single-electron model, given by $k = 1 - (1 - [\alpha Z]^2)^{1/2}$. Figures in parentheses indicate the power of 10 by which the number must be multiplied.

Z	α_1	α_2	α_3	α_4	α_5
10	7.329(3)	8.184(5)	4.281(7)	1.340(9)	2.867(10)
20	4.510(2)	1.251(4)	1.596(5)	1.232(6)	6.459(6)
30	8.720(1)	1.030(3)	6.060(3)	1.922(4)	4.338(4)
40	2.403(1)	1.606(2)	5.600(2)	9.300(2)	1.123(3)
50	1.085(1)	3.741(1)	8.317(1)	8.112(1)	5.926(1)
60	5.190(0)	1.081(1)	1.623(1)	1.035(1)	4.834(0)
70	2.713(0)	3.604(0)	3.721(0)	1.598(0)	5.479(−1)
80	1.636(0)	1.334(0)	9.516(−1)	3.152(−1)	8.995(−2)
88	9.989(−1)	6.622(−1)	3.551(−1)	1.094(−1)	2.977(−2)
96	6.691(−1)	3.861(−1)	1.848(−1)	4.991(−2)	8.452(−3)
Z	β_1	β_2	β_3	β_4	β_5
10	4.222(2)	2.219(5)	3.472(7)	2.587(9)	1.124(11)
20	1.087(2)	1.415(4)	5.471(5)	9.874(6)	1.084(8)
30	5.075(1)	2.893(3)	4.857(4)	3.919(5)	1.841(6)
40	3.072(1)	8.942(2)	8.830(3)	3.892(4)	1.003(5)
50	2.123(1)	3.881(2)	2.374(3)	6.466(3)	1.032(4)
60	1.737(1)	2.033(2)	8.215(2)	1.484(3)	1.626(3)
70	1.548(1)	1.225(2)	3.393(2)	4.257(2)	3.158(2)
80	1.528(1)	8.304(1)	1.605(2)	1.436(2)	7.637(1)
88	1.764(1)	6.582(1)	9.549(1)	6.576(1)	2.714(1)
96	2.313(1)	5.608(1)	6.060(1)	3.394(1)	1.034(1)

6488

Brookhaven National Lab.

ISOMERISM OF Sr^{85}; by A. W. Sunyar, J. W. Mihelich, G. Scharff-Goldhaber, M. Deutsch, and M. Goldhaber. [nd] (AECU-1625)

The report is reporduced here in its entirety.

Sr^{85m} (70 min) decays via a two-step isomeric transition and a crossover transition to the ground state, and by K capture (~16%) to a 150-kev excited state of Rb^{85}. The lifetime determining step is a highly converted E3 transition of ~6 kev which is followed by an M1 transition of ~220 kev. The M4 crossover transition of ~226 kev has been observed in a 180° magnetic spectrograph. The conversion coefficient for the 220-kev transition is obtained by comparison of gamma-ray and conversion-electron intensities for the 150- and 220-kev transitions. Conversion electrons from the 6-kev transition have been observed in a flow proportional counter and an ion chamber. The main isomeric transition proceeds as follows: p $1/2 \xrightarrow{6\ kev}$ $7/2+ \xrightarrow{220\ kev}$ g $9/2$. The $7/2+$ state involves coupling of 7 odd neutrons in g $9/2$ orbits as previously noted for several isomeric transitions. The intensity of the M4 crossover transition agrees with that expected from the semiempirical formula of Goldhaber and Sunyar (Phys. Rev. 83, (1951) Sept. 1). The ground state of Sr^{85} (65 day) decays by K-capture to an excited state of 510 kev for which a half life of $(0.9 \pm 0.2)\ \mu$ sec has been established. A decay scheme consistent with shell theoretical predictions and experimental evidence for the decay of Kr^{85}, Rb^{85}, and Sr^{85} will be discussed.

6489

Radiation Lab., Univ. of Calif.

NEW ISOTOPES OF BERKELIUM AND CALIFORNIUM; by E. K. Hulet, S. G. Thompson, A. Ghiorso, and K. Street, Jr. Apr. 9, 1951. 5p. (UCRL-1224)

A target containing ~100 μg of Cm^{242}, ~5μg of Cm^{243}, and ~μg of Cm^{244} was bombarded with 35-Mev He ions and 16-Mev deuterons. α-particle groups of 6.33 ± 0.05 (18%), 6.15 ± 0.05 (48%), and 5.90 ± 0.05 (34%) Mev, each of 4.95 ± 0.01-day half life, were observed and attributed to Bk^{245}, a K-capturing isotope with ~1% α-branching. The partial α half life is thus 15 yr. The three α-particle groups of 4.6-hr Bk^{243} also were observed. The half life of the daughter Cm^{245} must be at least 500 yr. The Cf fraction showed only 6.75-Mev α particles attributed to β-stable Cf^{246} of 35.7 0.5-hr half life.

6490

Brookhaven National Lab.

ANGULAR CORRELATION OF Rh^{106}(abstract); by J. J. Kraushaar. [nd] 1p. (AECU-1626)

The report is reproduced here in its entirety.

The spectrum of Rh^{106} has been analyzed by a NaI scintillation spectrometer. The energies and relative intensities of the five main gamma rays have been determined and agree well with the values reported in the previous abstract. The partial decay scheme, consistent with the beta- and gamma-ray intensities, has been investigated in order to explain the discrepancy between the measured angular correlation (Brady and Deutsch, Phys. Rev. 78, 5, (1950)) and the calculated one for a 0-2-0 quadrupole-quadrupole transition. The effect of the 1.04-0.51-Mev gamma-ray cascade in competition with the 0.62-0.51 cascade is to lessen the expected values of $\epsilon(\theta)$ for a 0-2-0 transition in proportion to the intensity, relative efficiency of the counters, and values of $\epsilon(\theta)$ for the competing cascade.

The contribution of the 1.04-0.51 transition is not enough with these considerations to explain the discrepancy. It

may be that a loss of memory in the angular correlation of the 0-2-0 transition is involved. The correlation of the higher energy cascade has been roughly determined by differential and integral discrimination.

6491
DIRECTIONAL CORRELATION BETWEEN SUCCESSIVE INTERNAL-CONVERSION ELECTRONS: II. J. W. Gardner. Proc. Phys. Soc. (London) 64A, 238-49(1951) Mar.

A previous paper examined the directional correlation $I(\theta)$ between two conversion electrons in cascade, each electron being ejected, with energy much less than mc^2, from an initial s-state, under the action of a pure electric multipole γ-transition, and $I(\theta)$ was shown to be completely determined by symmetry arguments alone in this case. In the present paper we consider the same problem for pure magnetic, and for mixed transitions. Here $I(\theta)$ usually appears as a weighted mixture of constituents $I_1(\theta)$, $I_2(\theta)$, etc., each of which is completely determined by symmetry arguments alone. The weight factors, however, must be determined from standard internal-conversion theory. (auth)

6492
ORIGIN OF ATMOSPHERIC ARGON AND THE RADIOACTIVE DECAY CONSTANTS OF POTASSIUM-40. J. H. J. Poole and C. F. G. Delaney. Nature 167, 680-1(1951) Apr. 28. (Letter to the editor)

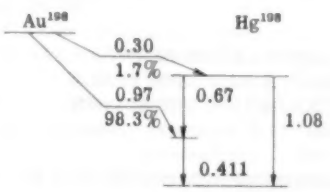
It is postulated that either atmospheric argon is not derived from K^{40} in the earth's crust or, if the low branching ratio of K^{40} is correct, argon can escape from a considerable depth in the crust. It is suggested that a small percentage of the argon generated might escape through volcanic or similar action.

6493
ON THE ISOMETRY OF Sb^{120}. J. P. Blaser, F. Boehm, P. Marmier, and H. Wäffler. Helv. Phys. Acta 24, 245-6 (1951) July 10. (In German)

A 6-day isomer of Sb^{120} (15 min), described by Lindner and Perlman (Phys. Rev. 73, 1124(1948)), has since been accepted in all isotope lists; a 1.1-Mev γ ray, conversion electrons, and a K-capture radiation were given by the authors as the characteristics of this isomer. It is reported here that in the course of a comprehensive study of cross sections for (p,n) and (γ,n) reactions, an unsuccessful search was made for the isomer; none of the activities were observed among the products both of the Sn(p,n)Sb reaction (using 6.8-Mev protons of a cyclotron), and of the Sb(γ,n)Sb reaction (using 32-Mev rays of a betatron).

6494
SPECTROMETRIC STUDY OF THE γ RADIATION OF Au^{198}. Pierre Hubert. Compt. rend. 232, 2201-3(1951) June 11. (In French)

The γ radiation of Au^{198} was studied to 3.5 Mev with a spectrometer able to detect radiation having an intensity 3×10^{-4} that of the 0.411-Mev line. The following decay scheme is suggested:



The internal-conversion coefficients of the 0.411-Mev γ ray were found to be $\alpha_K = (3 \pm 0.1) \times 10^{-2}$ and $\alpha_{L+M} = (1.5 \pm 0.1) \times 10^{-2}$. No other conversion rays were found, the precision of the measurements permitting observation of $\alpha = 0.5 \times 10^{-3}$.

6495
4.4-MINUTE RADIATIONS FROM Zr^{89}. F. J. Shore, W. L. Bendel, and R. A. Becker. Phys. Rev. 83, 688-9(1951) Aug. 1. (Letter to the editor)

79.3-hr Zr^{89} has been investigated with a 180° magnetic spectrometer. The results indicate a simple positron spectrum with an allowed shape having a Kurie end point at 890 ± 10 kev, and in addition a single K-conversion line at 896 ± 5 kev. The isomeric transition of 588 kev in Zr^{89} was studied. The half life of 4.4 ± 0.1 min and K-conversion coefficient of 0.06 ± 0.02 indicate that the transition is magnetic 2^4 pole. Absorption, magnetic-spectrometer, and scintillation-spectrometer results indicate a weak positron group of ~2.5 Mev, apparently a direct transition from the 588-kev state of Zr^{89} to the ground state of Y^{89}. The isomeric level of Zr^{89} is assigned to the $P_{1/2}$ state, and the ground level to the $g_{9/2}$ state.

6496
EMISSION OF LONG-RANGE PARTICLES IN THE FAST NEUTRON TERNARY FISSION OF U-238 AND Th-232. E. W. Titterton. Phys. Rev. 83, 673-4(1951) Aug. 1. (Letter to the editor)

Two sets of plates, each including Ilford C2 and D1 emulsions, were loaded with U acetate and Th nitrate, respectively, and were exposed to neutrons of energy 2.5 Mev. Fission events having light fragments of range in excess of 60 μ could not have been due to a chance juxtaposition of tracks. Search of the U-loaded emulsions yielded 8 cases of tenary fission with the emission of a light, charged fragment of range greater than 60 μ among 12,000 binary fissions. In the case of the Th-loaded emulsion 14,000 fission events were examined. Seven events were found having light fragments of range 60 μ. The light particle appears to be an α particle and is emitted preferentially near 90° from the heavy fragments.

6497
INVESTIGATIONS ON THE β RADIOACTIVITY OF B^{12} AND Li^8. Georges Vendryes. Compt. rend. 233, 391-3(1951) July 30. (In French)

A low-intensity disintegration of B^{12} leading to an excited state of C^{12}, probably that of the 4.5-Mev level, was found through measurements of the γ radiation to constitute 4 ± 1% of the whole β decay, the main branching ending in the ground state of C^{12}. Considerations on the ft values of the two transitions (both allowed) point to even parity and to total angular momentum of 1 for both B^{12} and C^{12*}. In another series of observations, a very feeble component of the β activity of Li^8 was detected after allowing for the background and the parasites. It forms probably 2 ± 1% of the total radiation and leads perhaps to the 4.9-Mev level of Be^8; the ft value indicates a forbidden transition. This radiation is too weak to account for the excess over theory observed by Harnyak et al. (Phys. Rev. 77, 160(1950)) in the β decay of Li^8.

6498
ON THE K-CAPTURE/POSITRON BRANCHING RATIO FOR Cu^{61}. C. Sharp Cook. Phys. Rev. 83, 462-3(1951) July 15. (Letter to the editor)

The K-capture/positron ratio for the decay of Cu^{61} is calculated by combining the results of two experiments, neither of which required instrumental correction factors. The K-capture/positron ratio measured by Reynolds (Phys. Rev. 79, 789(1950)) and the ratio $(K/\beta^+)_{64}/(K/\beta^+)_{61}$ measured by Bradt et al. (Helv. Phys. Acta 18, 252(1945)) combine to give a value of 0.47 for the $(K/\beta^+)_{61}$ ratio, in excellent agreement with the anticipated theoretical value of 0.52.

6499
ABSORPTION CORRECTIONS FOR RADIUM STANDARDIZATION. G. M. Keyser. Can. J. Phys. 29, 301-9(1951) July.

The absorption corrections necessary for radium standardization have been redetermined. The measuring equipment and technique have been investigated to find the conditions necessary for minimum error. A lead filtered, aluminum walled chamber was found to have the best characteristics. The electronic absorption coefficients measured with this chamber fit an empirical formula depending only on the atomic number. This formula gives a value for the absorption coefficient of radium salts which was compared with a direct experimental value. (auth)

6500
ANGULAR CORRELATION OF ANNIHILATION RADIATION FROM POSITRONS DECAYING IN SEVERAL SUBSTANCES. J. B. Warren and G. M. Griffiths. Can. J. Phys. 29, 325-35(1951) July.

Using anthracene scintillation counters in coincidence, the angular correlation between annihilation quanta produced by the decay of positrons in the following materials has been measured: the pure elements Mg, S, Cu, Sn, Pt, and Hg, and the chemical compounds LiCl, KCl, CsCl, KF, and KI. Calculations were performed to determine the effect of the geometry on the shape of the angular correlation curves, and the effects of scattering were investigated. The curves for Cu, Pt, and possibly Hg could be approximated to by the expression $C(\theta) = Ke^{-\theta/\theta_0}$, where $C(\theta)$ is the coincidence counting rate as a function of θ, the angular departure of the two quanta from collinearity, and K and θ_0 are constants. The curves for the other materials are more complicated and suggest that there is a relation between the shape of the curves and the outer electronic structure of the atoms with which the positrons annihilate. In alkali halides the positrons appear to annihilate only against the outer electrons of the negatively charged halogen ions. (auth)

6501
NUCLEAR ISOMERS OF Ba^{135} AND Ba^{133}. R. D. Hill and F. R. Metzger. Phys. Rev. 83, 455(1951) July 15. (Letter to the editor)

Spectrographic analysis of the activity of Ba^{135m} has shown the presence of lines caused by the K and L conversion of a 269 ± 2-kev γ transition, with $N_k/N_l = \sim 2$ and a half life of ~ 30 hr. By means of a NaI scintillation counter a value of 3.5 ± 1.5 was obtained for the K-conversion coefficient. Similar analysis of Ba^{133m} showed the presence of K-, L-, and M-conversion lines from a 275.5 ± 1 Mev γ transition, with a K-conversion coefficient of 3 ± 1. The lifetimes of both isomers agree extremely well with the theoretical values for magnetic 2^4 transitions, viz., 45 hr for Ba^{135m} and 42.5 hr for Ba^{133m}.

6502
ON SOFT PHOTON EMISSION IN RADIATION PROCESSES. H. Primakoff and F. Villars. Phys. Rev. 83, 686(1951) Aug. 1. (Letter to the editor)

The intensity of the soft-photon spectrum emitted in ordinary hard-photon radiation processes is evaluated. A correction factor is given for the effect of soft photons on the usual hard-photon line shape, and the displacement of the energy of an emitted hard photon is calculated. The soft-photon effect is so small that any measurement of the emitted hard photon or ejected photoelectron energy, by extrapolation of the corresponding line shape on the high-energy side, will be independent of the actual presence of the soft photon emission to about 1 ppm.

6503
MEASUREMENT OF GAMMA-RAY MOMENTA AND THE THRESHOLDS OF THE PHOTO-DISINTEGRATIONS $^{12}C \rightarrow 3^4He$ and $^{16}O \rightarrow 4^4He$. F. K. Goward and J. J. Wilkins. Proc. Phys. Soc. (London) 64A, 93-4(1951) Jan. (Letter to the editor)

It is explained how momentum unbalance analysis of stars as described previously by the authors (Proc. Phys. Soc. (London)63A, 662; 63B, 1171(1950)) can be adapted to measurement of reaction thresholds. This method is the only recourse available when suitable monochromatic sources are not available (e.g., no available monochromatic source gives $O^{16} \rightarrow 4He^4$ stars), and it provides additional evidence on the correct identification of stars. Histograms are shown of reaction thresholds obtained by momentum unbalance analysis from 275 $C^{12} \rightarrow 3He^4$ stars and 111 $O^{16} \rightarrow 4He^4$ stars. It is also noted that the described techniques can provide a test of the equation $p = h\nu/c$.

6504
COINCIDENCES BETWEEN β AND γ RAYS IN THE DISINTEGRATION SPECTRUM OF B^{12}. Georges Vendryes. Compt. rend. 232, 1549-51(1951) Apr. 23. (In French)

Coincidence studies have been made of the 0.025-sec B^{12} produced by intermittent (1/100-sec) 600-kv deuteron bombardment of B. The presence of a very soft β component, estimated at 5%, is confirmed. Although the limit of this component's decay could not be fixed with precision, it apparently is the known 4.5-Mev level of C^{12}.

6505
THE INTERNAL CONVERSION RADIATION OF IONIUM. P. Falk-Vairant and J. Teillac. J. phys. radium 12, 659-64 (1951) June. (In French)

The α particle–conversion electron coincidences of Po and Io (Th^{230}) have been studied, the Po being used to determine the behavior of the counter arrangement. The number of conversion electrons arising from the 68-kev transition in Ra was found to be 22 per 100 disintegrations of Io. This result is in agreement with previous studies of the α fine structure and γ radiation.

6506
THE POSITRON TO γ-RAY RATIO IN Zn^{65}. George M. Griffiths. Phys. Rev. 83, 852(1951) Aug. 15.

Coincidence measurements were made of a 250-day Zn^{65} source which indicate a ratio of 1 positron to 65 ± 5 γ rays.

6507
GAMMA-RADIATION FROM LANTHANUM 140. J. M. Cork, A. E. Stoddard, J. M. LeBlanc, C. E. Branyan, D. W. Martin, and W. J. Childs. Phys. Rev. 83, 856-7(1951) Aug. 15. (Letter to the editor)

New γ-ray energies are reported in the β decay of fission-product La^{140} to Ce^{140}. An energy-level diagram is given for Ce^{140}. (see also NSA 4-1319)

6508
THE RADIOACTIVITY OF BARIUM 140. J. M. Cork, J. M. LeBlanc, A. E. Stoddard, D. W. Martin, C. E. Branyan, and W. J. Childs. Phys. Rev. 83, 856(1951) Aug. 15. (Letter to the editor)

New γ-ray energies are reported in the β decay of fission-product Ba^{140} to La^{140}. An energy-level diagram is given for La^{140}.

6509
ANGULAR CORRELATION BETWEEN THE ELECTRON GENERATED IN A PAIR CONVERSION AND THE γ QUANTUM EMITTED DURING THE SUBSEQUENT NUCLEAR TRANSITION. A. Z. Dolginov. Doklady Akad. Nauk S.S.S.R. 77, 237-40(1951). (In Russian)

Internal conversion with emission of a pair occurs chiefly in light nuclei and in cases involving high excitation energies, i.e., under conditions when the determination of angular momenta of excited nuclei by using the ordinary conversion presents difficulties. A formula is derived here giving the angular correlation between the electron of the pair con-

version and the γ ray emitted during the immediately following transition of the nucleus from an excited level; the formula is valid for any multipolarity both of the conversion and of the subsequent transition.

6510
THE γ EMISSION OF Co^{60}. B. Dzhelepov, N. Zhukovskiĭ, and Yu. Khol'nov. Doklady Akad. Nauk S.S.S.R. 77, 233-6 (1951). (In Russian)

The γ radiation of Co^{60} was studied with a γ-ray spectrometer measuring coincidences of Compton electrons from a thin cellophane film. The two counters, made of cellophane 17 μ thick, were filled with He at 32-cm pressure. The spectrum consisted of two lines whose maxima, before the calibration of the instrument with the aid of known γ lines, were at 1230 and 1390 kev; the calibration furnished a factor for obtaining the true energy of the quanta with an accuracy of ±1%. The relative intensities of the lines were determined from their areas, after allowing (1) for the dependence of the probability of the Compton effect and of the self-absorption of γ rays on the energy of the quanta, and (2) for the dependence of the efficiency of the counters on the energy of the electrons. The intensity ratio, which measures the ratio of the numbers of quanta per disintegration, was found to be 0.98 ± 0.04. Its closeness to unity confirms the assumption that the two quanta succeed each other in cascade.

6511
THE BETA-SPECTRUM OF S^{35} USING WINDOW CORRECTIONS. R. B. Heller, E. F. Sturcken, and A. H. Weber. Phys. Rev. 83, 848-9(1951) Aug. 15. (Letter to the editor)

The β spectrum of S^{35} was obtained with a thin-lens spectrometer and corrected for nylon-window absorption. The corrected data is linear down to about 32 kev. The results constitute additional evidence that the β spectrum of S^{35} is an allowed Fermi spectrum.

6512
THE RADIATIONS OF ^{203}Hg AS OBSERVED BY A NEW METHOD. H. W. Wilson and S. C. Curran. Phil. Mag. 42, 762-74(1951) July.

The radioactivity of mercury has been investigated in a new way which makes use of the integrating properties of a proportional counter with an internal source. These allow us to show that the β spectrum is of allowed shape from 20 kev to the end point, which was found to be 210 ± 5 kev. The energy and internal conversion coefficients of the γ ray which follows the β emission have been evaluated. Also the half life has been determined as 45.9 ± 0.5 days. A discussion of the decay scheme and further possible use of the technique including its extension to scintillation counters concludes the paper. (auth)

6513
BETA-RADIOACTIVITY PHENOMENA. S. R. de Groot. Nederland. Tijdschr. Natuurk. 17, 78-104(1951) Mar. (In Dutch)

Recent developments of the neutrino theory of β radioactivity, especially those due to Dutch workers, are outlined (de Groot, Nederland. Tijdschr. Natuurk. 14, 328(1948); Tolhoek, ibid. 15, 96(1949); Bouchez et al., J. phys. radium 11, 105(1950)). Experimentally insufficiently investigated problems of the β-ray polarization in a magnetic field at low temperatures (Tolhoek et al., Compt. rend. 230, 1580 (1950)), of double β emissions, and of the nuclear recoil due to a neutrino emission during a K-capture are discussed.

6514
THREE-QUANTUM DECAY OF POSITRONIUM. Martin Deutsch. Phys. Rev. 83, 866-7(1951) Aug. 15. (Letter to the editor)

The rate of decay by 3-photon annihilation of orthopositronium has been determined experimentally to be $\lambda_0 = 6.8 \pm 0.7 \times 10^{-6}$ sec^{-1}, in excellent agreement with $\lambda_0 = 7.2 \times 10^6$, the theoretical value calculated by Ore and Powell (Phys. Rev. 75, 1696(1949)). The rate of decay of annihilation radiation in CCl_2F_2 and O_2 is plotted against pressure.

6515
DISINTEGRATION OF Sn^{119m}. R. D. Hill. Phys. Rev. 83, 865-6(1951) Aug. 15. (Letter to the editor)

Conversion electrons from an enriched Sn^{119m} source show strongly converted transitions of 65.3 ± 0.5 and 24.2 ± 0.5 kev. K/L and L/M ratios support assignments of magnetic 2^4-pole and 2^1-pole character to the larger and smaller transitions, respectively.

6516
ANGULAR CORRELATION IN THE TRIPLE CASCADE TRANSITIONS. L. C. Biedenharn, G. B. Arfken, and M. E. Rose. Phys. Rev. 83, 586-93(1951) Aug. 1.

The theory of the angular correlation between the radiations involved in three successive nuclear transitions is presented. The formalism is applicable to the case of three successively emitted radiations as well as to the case in which one of the emission processes is replaced by an absorption process. Thus, applications are made to (1) the emission of three cascade gamma-rays and (2) to the double-cascade gamma-emission following capture of particles with nonzero orbital angular momentum. In some cases the angular correlation depends on the order of the transitions. Under process (2), special results are presented which are applicable to $B^{11}(p,\gamma,\gamma)C^{12}$. It is also pointed out that the formalism properly describes the angular correlation in all processes wherein three directions are specified, and is therefore applicable when one of these directions refers to a polarization state while the other two refer to propagation vectors. Results are given for the limitation on anisotropy for the triple cascade transition with two radiations parallel or antiparallel and for two radiations in cascade with intervening radiations unobserved. (auth)

6517
A SEARCH FOR SHORT PERIOD ACTIVITIES FROM U^{235} FISSION PRODUCTS. J. E. Brolley, Jr., D. H. Cooper, Wm. S. Hall, M. S. Livingston, and L. K. Schlacks. Phys. Rev. 83, 990-3(1951) Sept. 1.

A search for gamma-ray activities with period 1 to 100 msec from thermal neutron fission of U^{235} gave negative results. 0.43 ± 0.03 sec was the shortest observed. The period of B^{12} was found to be 27 ± 3 msec. The cyclotron beam was pulsed to supply 1 to 10 msec neutron bursts. Coincidence scintillation detectors were employed. (auth)

6518
RADIATIONS FROM Br^{77} AND Ni^{57}. Robert Canada and Allan C. G. Mitchell. Phys. Rev. 83, 955-9(1951) Sept. 1.

The nuclear spectra of Br^{77} (58 hr) and Ni^{57} (36 hr) have been investigated in a magnetic lens spectrograph. Br^{77} decays by orbital electron capture and positron emission to Se^{77}. Br^{77} emits a single positron group of energy 0.336 Mev together with gamma rays of energy 0.160, 0.237, 0.284, 0.298, 0.520, 0.641, and 0.813 Mev, of which the lines at 0.160, 0.237, and 0.520 Mev are internally converted. Br^{77} is the parent of the metastable state Se^{77m} of 17-sec half life, and the energy of the gamma ray associated with this transition is 0.160 Mev.

The radiations from Ni^{57} consist of one positron group whose end point is 0.835 Mev together with one strong gamma ray of energy 1.375 Mev and two weaker gamma rays whose energies are 1.91 and 0.128 Mev, the latter being internally converted. (auth)

6519
GAMMA-RADIATION ASSOCIATED WITH RADIUM AND DAUGHTER PRODUCTS. J. M. Cork, C. E. Branyan,

A. E. Stoddard, H. B. Keller, J. M. LeBlanc, and W. J. Childs. Phys. Rev. 83, 681-2(1951) Aug. 1. (Letter to the editor)

An investigation has been made of the energies of the γ rays emitted by the various decay products of Ra. A resurvey of the electron lines due to internal conversion and to photoemission from various radiators was carried out in spectrometers calibrated by the known energies of the I^{131} γ rays with extrapolated field values above 400 kev. A thorough study was made of the low-energy γ radiations in RaE (Bi^{210}) following β emission from strong sources of RaD. No evidence could be found for the existence of the 23-kev γ as reported by Tsien (Phys. Rev. 69, 38(1946)) nor for his other low-energy radiations. Several other adjustments in previously reported energies are made. Observed electron energies, relative intensities and interpretation are summarized in a table, and the γ rays are shown collectively in a modified decay diagram.

6520

ENERGY DEPENDENCE OF THE BETA-GAMMA ANGULAR CORRELATION IN Sb^{124}. E. K. Darby and W. Opechowski. Phys. Rev. 83, 676-7(1951) Aug. 1. (Letter to the editor)

The β-γ differential correlation coefficient $a(E) = [W(\pi,E) - W(\frac{1}{2}\pi,E)/W(\frac{1}{2}\pi,E)$, where $W(\theta,E)$ is the β-γ correlation function for the β energy E, has been measured for Sb^{124}. First the integrated angular correlation was determined using as a β counter 20 mg/cm^2 of anthracene flakes and as a γ counter a ½-in. thick crystal of anthracene, both in conjunction with RCA 5819 photomultipliers. The results fitted closely a curve $1 - 0.23\cos^2\theta$. Next, in order to measure the differential angular correlation, the thin β counter was replaced by a ½-in. thick anthracene crystal so that pulses proportional to the β energy were obtained. A coincidence mixer was used to control a gate circuit between the β pulses and a 12-channel kicksorter. Results of four separate measurements are plotted, together with curves calculated for two possible assignments of the nuclear states involved.

6521

24-MINUTE RADIATIONS FROM Ag^{106}. W. L. Bendel, F. J. Shore, and R. A. Becker. Phys. Rev. 83, 677(1951) Aug. 1. (Letter to the editor)

The radiations of Ag^{106} have been investigated. The sources were produced by irradiation of thin silver foils with 22-Mev x rays, employing the probe method. The half life was determined to be 24.0 ± 0.2 min. Using a 180° magnetic spectrometer, two groups of positrons were found with maximum energies of 1.945 ± 0.015 (71%) and 1.5 ± 0.1 Mev (29%). A weak conversion line at 0.5 Mev was found. In each case log ft = 4.93. Zero spin is assigned to the ground state of Pd^{106}, a spin of 2 to the excited state, and a spin of 1 for the Ag^{106} parent state. A very weak continuous negatron component of ~24-min half life and γ rays of energy greater than 0.6 Mev were also indicated.

6522

RADIOACTIVE DECAY OF I^{131}. E. W. Emery. Phys. Rev. 83, 679-80(1951) Aug. 1. (Letter to the editor)

The intensity of the 80-kev γ radiation in the decay of I^{131} to Xe^{131} has been assessed as 2.6 quanta per 100 disintegrations by measurement of the ionization in a Cu chamber. This small value leads the author to conclude that the decay scheme of Metzger and Deutsch (Phys. Rev. 74, 1640(1948)) is the best yet proposed. To this scheme he proposes the addition of two more levels: a 164-kev metastable state following a weak (0.8%) 800-kev β and a 720-kev state following a 244-kev β (5%).

6523

ON INTERNAL RECOMBINATION IN β EMISSION. Michel Fabre de la Ripelle. Compt. rend. 232, 1655-7(1951) Apr. 30. (In French)

The probability of an electron, emitted in β decay, entering an atomic orbit of the same atom, thus being unobserved, has been calculated by a dipole approximation, the influence of nuclear coulomb field and relativity corrections being neglected. The probability is very small. For the effect to be important the β-emitting nucleus would have to be bare and of high Z, a practicably unrealizable case.

6524

THE ENERGY OF THE METASTABLE STATE OF Ba^{135}. W. H. Cuffey and Robert Canada. Phys. Rev. 83, 654(1951) Aug. 1. (Letter to the editor)

The energy of the γ ray from the 28.7-hr metastable state of Ba^{135} has been measured by means of a scintillation spectrometer consisting of a NaI(Tl) crystal and an RCA 5819 photomultiplier tube. The amplified pulses triggered the sweep of an oscilloscope, and time exposures of the pulses displayed on the oscilloscope were taken. A photopeak and a Compton peak for a line at 0.270 Mev appeared. The energy of the internal-conversion electrons was measured in a magnetic lens spectrometer. A K and an L peak were found, corresponding to K and L conversion for a line of energy 0.267 Mev.

6525

NEW METHOD FOR THE PREPARATION OF ARTIFICIAL RADIOELEMENTS WITHOUT THE USE OF CARRIERS. Marius Chemla and Pierre Süe. Compt. rend. 233, 247-9 (1951) July 16. (In French)

P^{32} and S^{35}, produced by fast neutrons in NaCl, diffuse toward the surface of the crystal upon heating (Compt. rend. 232, 1553, 2424(1951)). S^{35} is captured by a stream of H_2 and transferred to a water solution of Br, by bubbling. P^{32} is carried along with NaCl vapors and deposited on the walls of the tube containing the crystal. (auth)

6526

ON THE THEORY OF BETA-RADIOACTIVITY. II. A THEORETICAL DISCUSSION OF THE POLARIZATION OF ELECTRON BEAMS AND ITS OBSERVATION. H. A. Tolhoek and S. R. De Groot. Physica 17, No. 1, 1-16(1951) Jan.

A number of properties of polarized electron beams are investigated in view of an application to polarized β rays emitted from nuclei with aligned spins. The state of polarization of electron beams, polarized or unpolarized, can be characterized by a density matrix with two rows and columns for a pair of fundamental (orthogonal) states which serve to characterize the spin orientation. It is found that in order to determine completely the polarization of a beam the determination of three independent orientation coefficients is necessary. The polarizations of light and of electron beams have been compared.

6527

ON THE THEORY OF BETA-RADIOACTIVITY. III. THE INFLUENCE OF ELECTRIC AND MAGNETIC FIELDS ON POLARIZED ELECTRON BEAMS. H. A. Tolhoek and S. R. De Groot. Physica 17, No. 1, 17-32(1951) Jan.

The influence of electric and magnetic fields on the spin orientation (polarization) of electrons in a beam is calculated according to the Pauli spin theory and the Dirac theory. For the cases, where the field is perpendicular or parallel to a polarized electron beam, the following results are found. Transverse electric field. In the nonrelativistic approximation the spin orientation remains constant in space, even if the beam is deflected; the relativistic formula gives for the ratio of the rotation of the spin orientation and the angle of deflection of the beam: E_{kin}/E (ratio of kinetic energy and total energy, i.e., including the rest mass). Transverse magnetic field. The spin orientation does not change in relation to the direction of propagation. Longitudinal electric field. Though the beam is accelerated (or retarded) the spin orientation remains constant in space.

Longitudinal magnetic field. The spin orientation rotates about the direction of propagation. It is shown that longitudinal polarization of electron beams (spins parallel or antiparallel to the direction of propagation) can be observed by means of an electric deflection of the beam and a scattering experiment in succession.

6528
DOUBLE BETA-DECAY AS A FIRST-ORDER PROCESS. Rolf G. Winter. Phys. Rev. 83, 1070-1(1951) Sept. 1. (Letter to the editor)

A new approach to the theory of double β decay is developed. To the Fermi Hamiltonian a term is added which couples two electrons to the nucleus in the same manner as that used in Fermi theory to couple one electron and one neutrino to the nucleus. This term is to contain a bilinear combination of creation operators which create two electrons in antisymmetric states only. The term considered will also make possible the emission of two electrons followed by the absorption of one of these electrons with the emission of a neutrino, that is, a second-order contribution to single beta decay. This contribution to single beta decay is perhaps 10^{-30} as large as the first-order process.

6529
THE RADIATION OF Tl^{199} AND Tl^{200}. Harvey I. Israel and Roger G. Wilkinson. Phys. Rev. 83, 1051(1951) Sept. 1. (Letter to the editor)

The internal-conversion-electron spectrum of $Hg^{199,200}$ resulting from the orbital-electron decay of $Tl^{199,200}$ has been studied with a small 180° shaped-field spectrometer. An analysis of the conversion lines of Tl^{199} showed that they arise from nine γ rays of energies 49, 78, 103, 157, 206, 245, 332, 454, and 490 kev. The 157- and 332-kev γ rays appear to be in cascade, the 490-kev γ representing the cross-over transition. The 245- and 206-kev γ rays also appear to be in cascade, and the 454-kev γ results from the cross-over transition. The Tl^{200} observed conversion lines correspond to six γ rays of energies 365, 577, 622, 829, 1210, and 1360 kev. No positrons were found in the case of either Tl^{199} or Tl^{200}.

6530
BETA-RAY SPECTRUM OF K^{40}. Myron L. Good. Phys. Rev. 83, 1054-5(1951) Sept. 1. (Letter to the editor)

The β-ray spectrum of K^{40} has been measured by observing the distribution in size of the light flashes generated in a crystal of KI(Tl) by the natural radioactivity of the K of the crystal. The allowed Kurie plot of the corrected data is quite nonlinear. The result of applying the unique axial vector or tensor theoretical correction factor corresponding to the known spin change of four and assuming a parity change is a good fit to a straight line. The end-point energy obtained is 1.28 ± 0.03 Mev. The β-decay rate of K was measured as 27.1 ± 0.6 counts/sec/g.

6531
THE RATIO OF L TO K ELECTRON CAPTURE FOR Os^{185}. Maurice M. Miller and Roger G. Wilkinson. Phys. Rev. 83, 1050-1(1951) Sept. 1. (Letter to the editor)

The relative intensities of L and K x radiation following orbital-electron capture and subsequent internal conversion in several of the heavy elements have been determined from the pulse-height distributions obtained with a scintillation spectrometer. The measured ratio of L to K x radiation for Os^{185} was 0.40 ± 0.05. The corresponding ratio was approximately 0.50 for Re^{184}, 0.58 for Tl^{199}, and 0.65 for Tl^{200}. The ratio of L to K capture was calculated by combining the measured ratio of the x-ray intensities, probabilities of L and K capture, and fluorescent yields for transitions to the L level following K or L capture to be 0.35 ± 0.15. The disintegration scheme of Os^{185} is considered, and the atomic mass difference between Os^{185} and Re^{185} is estimated to be ~1.0 Mev if the transition to the 0.88-Mev level in Re^{185} is assumed to be first forbidden.

6532
GAMMA-RAYS FROM DEUTERON BOMBARDMENT OF B^{10}, B^{11}, N^{14}, AND F^{19}. James Terrell and G. C. Phillips. Phys. Rev. 83, 703-8(1951) Aug. 15.

A pair spectrometer has been used to analyze the high energy gamma-ray spectra produced by bombarding thick targets of natural boron, enriched boron, nitrogen, and fluorine with 1.56-Mev deuterons from a Van de Graaff generator. The B^{10} + d spectrum shows gamma-rays of energy 4.52 ± 0.10, 6.71 ± 0.13, and 9.04 ± 0.18 Mev; the spectrum from B^{11} + d, partially masked by the strong B^{10} + d gamma-rays, shows a single 4.5 ± 0.1-Mev gamma-ray. The nitrogen target produced strong gamma-rays of energy 5.33 ± 0.11, 7.40 ± 0.15, and 8.46 ± 0.17 Mev, with some indication of unresolved lines at 4.4 and 6.4 Mev. The F^{19} + d spectrum shows weak high energy gamma-rays, not previously observed, of energy 8.1 ± 0.4, 9.3 ± 0.3, and 11.5 ± 0.4 Mev; a level in Ne^{20} at 11.5 ± 0.4 Mev is indicated. In any of these spectra lower energy gamma-rays may be present though undetected, because of the large variation of spectrometer sensitivity with energy. Absolute yield values are estimated for each of these gamma-rays. (auth)

6533
EXPLICIT γ-γ ANGULAR CORRELATIONS. Stuart P. Lloyd. Phys. Rev. 83, 716-20(1951) Aug. 15.

The theoretical γ-γ directional correlation function is given as a Legendre series: $W(\theta) = 1 + \Sigma A_L P_L(\cos\theta)$, for those cases where the γ-rays are emitted with the lowest angular momentum allowed by selection rules. The coefficients A_L are given algebraically and are also tabulated as four-place decimals for all cascades up to 2^4-pole—2^6-pole in which the largest nuclear spin does not exceed nine. Rules are given for obtaining from the tables: (a) the lowest order multipole mixture interference terms, (b) certain α-γ and α-α directional correlations. (auth)

6534
RADIATIONS FROM F^{18}, Mo^{93}, and Cl^{34}. Lawrence Ruby and J. Reginald Richardson. Phys. Rev. 83, 698-700 (1951) Aug. 15.

The positron spectrum of F^{18} was investigated with a magnetic lens spectrometer and found to be of the allowed type with an upper limit at 649 ± 9 kev. The gamma-radiation from Mo^{93} was found to consist of three lines at 262 ± 2 kev, 692 ± 11 kev, and 1.51 ± 0.035 Mev. The K to L conversion ratio for the low energy line indicates 2^5 pole electric radiation. The positron spectrum of Cl^{34} consists of three components with upper limits at 4.45 Mev, 2.6 Mev, and 1.3 Mev. Gamma-ray lines were found at 3.3 Mev and 2.1 Mev and at 0.145 ± 0.003 Mev. The latter line gives rise to internal conversion electrons. (auth)

SPECTROSCOPY

6535
THE ANALYSIS OF THE INFRARED SPECTRUM OF CHLORINE MONOFLUORIDE. Alvin H. Nielsen and Ernest A. Jones. J. Chem. Phys. 19, 1117-21(1951) Sept.

The vibration-rotation fine-structure of the fundamental and first overtone of ClF has been resolved with grating spectrometers utilizing an 1800 lines-per-inch and a 3600 lines-per-inch grating. An analysis of the observed bands is given and the ω_e and $x_e\omega_e$ for $Cl^{35}F^{19}$ and $Cl^{37}F^{19}$ were found to be 786.34 cm^{-1}, 6.23 cm^{-1}, and 778.82 cm^{-1}, and 6.11 cm^{-1}, respectively. (auth)

THEORETICAL PHYSICS

6536

Brookhaven National Lab.

FREDHOLM STRUCTURES IN POSITRON THEORY; by Maurice Neuman. [nd] 5p. (AECU-1627)

The integral equation for the matter field in positron theory (the theory of a quantized Dirac field interacting with a given external electromagnetic field),

$$\psi(x) = \psi_0(x) + e\int^F K(xx')\psi(x')dx',$$

was investigated from the point of view of the Fredholm method. The symbol K^F is defined as

$$K^F_{\alpha\beta}(x,x') \equiv iS^F_{\alpha\sigma}(xx')\gamma^\mu_{\sigma\beta}A^\mu(x')$$

where $S^F(x)$ is the Feynman propagation function. It was found that the Fredholm determinant $D_0(e)$ derived from the expression for K^F is equal to the vacuum expectation value of the Heisenberg S-operator. A set of operators $\Delta_0(e)$, $\Delta_1(e)$, ... $\Delta_n(e)$ ... $[\Delta_0(e) \equiv D_0(e)]$ was also constructed whose matrix elements are determinantal representations of the nth particle parts of the S matrix. The set of operators

$$\left\{\Delta_n(e)\right\}$$

is isomorphic to a set of operators

$$\left\{D_n(e)\right\}$$

whose matrix elements are the nth Fredholm minors constructed on K^F. The Fredholm method is illustrated by consideration of the case of $\Delta_0(e)$.

6537

QUANTUM ELECTRODYNAMICS WITH NONVANISHING PHOTON MASS. F. Coester. Phys. Rev. 83, 798-800 (1951) Aug. 15.

A theory of neutral particles with spin 1 and arbitrary mass κ in interaction with electrons is developed in such a form that all observable results go over continuously into the corresponding results of ordinary quantum electrodynamics as $\kappa_0 \to 0$.

6538

A THEOREM OF USE IN WAVE THEORY. Edmund Pinney. J. Math. Phys. 30, No. 1, 1-10(1951) Apr.

Proof is given of a theorem which has been of considerable value in reducing the solutions of some problems in the theory of elastic waves to tractable form susceptible to numerical calculation. The theorem can be applied to regimes in which one or more wave velocities appear. In the theory of elastic waves there are two such wave velocities corresponding to irrotational and equivoluminar waves, respectively. It may have applications in the optical theory of crystals. The theorem is applied to finding expressions for surface displacements due to a P-wave point source in a semi-infinite medium.

6539

SINGULAR SOLUTIONS OF THE DIRAC EQUATIONS IN THE CASE OF A SURROUNDING MAGNETIC FIELD. J. Géhéniau and M. Demeur. Physica 17, No. 1, 71-5(1951) Jan. (In French)

The singular matrices of the Dirac equations, for an electron placed in a uniform and constant magnetic field, are calculated without approximation in respect to this field. Integral representations of S and S_F are given. (auth)

6540

A SCATTERING APPROXIMATION. A. L. Latter. Phys. Rev. 83, 1056-7(1951). Sept. 1. (Letter to the editor)

Scattering of a plane wave by a square well potential is treated in an approximation comparable in simplicity to the Born approximation but with the added feature of being exact at low energies as well as high.

6541

MOMENTUM REPRESENTATION OF THE COULOMB SCATTERING WAVE FUNCTIONS. E. Guth and C. J. Mullin. Phys. Rev. 83, 667-8(1951) Aug. 1. (Letter to the editor)

In a previous paper (Phys. Rev. 83, 667-8(1951)) the authors pointed out that a matrix element of the form $M = \int \psi_2^* V\psi_1 d\underline{r}$ where ψ_1 and ψ_2 are coulomb scattering wave functions of the type introduced by Gordon (Z. Physik 48, 180(1928)), can often be evaluated rather easily if ψ_1 and ψ_2 are expanded in terms of momentum wave functions. Explicit expressions for the momentum wave functions have now been derived.

6542

ON THE PSEUDOSCALAR VARIANT OF THE THEORY OF β DECAY. I. M. Shmushkevich. Zhur. Eksptl'. i Teoret. Fiz. 21, 661-3(1951) May. (Letter to the editor; in Russian)

It is generally thought that the spectra of allowed transitions have the same shape in all variants of the theory of β decay and that the angular correlation between the electron and the neutrino is described by the same expression, except for the value of a numerical coefficient. This thought is based on the assumption that the matrix element of the nuclear transition has a finite, nonzero, value when the momenta of the light particles (i.e., the electron and the neutrino) approach zero. However, it can be shown that such an assumption is not true in the pseudoscalar variant, in which, as is known, the interaction of nucleons with the field of light particles approaches zero as the velocities of heavy particles approach zero.

6543

FORMATION OF γ QUANTA AND OF NEUTRAL MESONS DURING CAPTURE OF π MESONS BY DEUTERONS. B. Ioffe, A. Rudik, and I. Shmushkevich. Doklady Akad. Nauk S.S.S.R. 77, 403-6(1951). (In Russian)

An examination is made of the 3 variants (1) $d + \pi^- \to n + n$, (2) $d + \pi^- \to n + n + \gamma$, and (3) $d + \pi^- \to n + n + \pi^0$. Assuming that the spin of π^- is zero, the scalar and the pseudoscalar mesons are alone considered. While for the scalar meson process (1) is strictly forbidden (the capture being assumed to proceed from the S level), in the case of the pseudoscalar meson (1) will compete with (2). However, a computation of (1) would present considerable difficulties, since it would require the knowledge of the wave function of the deuteron within the range of action of nuclear forces. A calculation is made of the probabilities of (2) and (3), using the perturbation treatment of the several variants of the meson theory of zero-spin particles.

6544

ON A FORMULATION OF QUANTUM ELECTRODYNAMICS. J. G. Valatin. Phys. Rev. 83, 850-1(1951) Aug. 15. (Letter to the editor)

A formulation of quantum electrodynamics is presented using an idea of Novobátzky but differing by introducing only two kinds of transverse and one kind of scalar photon, instead of the four kinds of photon variables of the Fermi electrodynamics. By means of a canonical transformation the scalar photon variables can be eliminated. The theory can also be built up by starting directly from the Heisenberg representation and introducing suitable energy-momentum expressions and the corresponding commutation rules.

6545
PRESENTATION OF QUANTUM MECHANICS. I. UNRELATIVISTIC WAVE EQUATIONS. B. Mrowka. Z. Physik 130, No. 2, 164-73(1951) June 29. (In German)

A brief method given by Madelung (Die mathematischen Hilfsmittel der Physikers, 4th edition, 1950) for derivation of Schroedinger's equations is generalized to treat complicated wave functions frequently encountered. As examples of the method, the wave equations for spin-free particles in a magnetic field and the unrelativistic Pauli equation for the spinning electron are derived.

6546
ON THE PROBLEM OF CAUSALITY IN THE QUANTUM THEORY OF ELEMENTARY PARTICLES. W. Heisenberg. Z. Naturforsch. 6a, 281-4(1951) June. (In German)

In connection with a previous work (Z. Physik 120, 513(1943)), possibilities are examined of limiting the deviations from causal behavior, which appear in Fierz's S-matrix theory, to small space-time regions. Furthermore, arguments in favor of an acceptance of such deviations from causality in the framework of a general theory of elementary particles are discussed. (auth)

6547
THE EXISTENCE OF WHEELER-COMPOUNDS. Aadne Ore. Phys. Rev. 83, 665(1951) Aug. 1. (Letter to the editor)

The simple Wheeler compound (Ann. N. Y. Acad. Sci. 48, 219(1946)) H^-e^+ is investigated by the variational method. A wave function is given which describes the system as a positronium atom coupled to a hydrogen atom. It is concluded that H^-e^+ is stable against dissociation by at least 0.07 ev.

6548
QUANTUM MECHANICS. Alfred Lande. New York, Pitman Publishing Corporation, 1951. 307p.

The book is intended to serve as an introduction to the subject and would presumably be suitable as a text in a one-year graduate course. There is a strong emphasis throughout on the physical background of quantum mechanics, particularly with respect to the complementary character of the wave and corpuscular representations. The topics covered are wave mechanics, matrix mechanics, nonconservative systems, spin, atomic and molecular spectra, and quantum statistics. A more complete review appeared in Rev. Sci. Instruments 22, 527(1951) July.

6549
ON THE RECIPROCAL FIELD THEORY. J. Rayski. Proc. Phys. Soc. (London) 64A, 657-8(1951) July. (Letter to the editor)

A complete quantum formalism for the nonlocal scalar fields including the interaction with the full reciprocal symmetry is derived. This formalism is free of the usual convergence difficulties.

6550
MATTER-LIKE AND QUANTUM PROPERTIES OF ELECTROMAGNETIC WAVE FIELDS. H. W. Konig. Acta Phys. Aust. 4, 405-30(1951) May. (In German)

Considerations on the energy concentration and energy propagation in electromagnetic wave fields suggest the concept of "phase particles" which consist of four "phase elements," possess a rest mass, and move with the phase velocity. A quantum-mechanical treatment of this picture leads to dispersion laws and all fundamental regularities governing micromatter and light. The confirmation of these ideas is sought in (1) experiments of Joffé and Dobronravow (Z. Physik 34, 889(1925)) on the quantum properties of x rays, giving (5 to 140) $\times 10^{-38}$ g as the rest mass of the photon, and (2) measurements by Shapley (Proc. Nat. Acad. Sci. U.S. 9, 5386(1923)) of the dispersion of light in the universe, resulting in a maximum value 7×10^{-38} for the photon's rest mass.

6551
A CORRECTION FACTOR TO GRAY'S THEORY OF IONIZATION. Ali A. K. Ibrahim. Proc. Phys. Soc. (London) 64A, 509-10(1951) May. (Letter to the editor)

A modification of Gray's equation for the energy absorption in ionization is given which agrees approximately with the experimental results of the author and C. W. Wilson (unpublished). In the case of photoelectrons an additional term was found to be required to account for the binding energy of the electron in the atom.

6552
GENERAL THEORY OF DAMPING PHENOMENA FOR NON-STATIONARY PROCESSES. I. FUNDAMENTALS AND RELATIONSHIPS WITH THE S-MATRIX FORMALISM. E. Arnous and S. Zieman. Helv. Phys. Acta 24, 279-95 (1951) July 10. (In German)

The damping theory of discrete states is adapted to the positron theory in an operator form. A solution of HEITLER's integral equation can be obtained in closed form and an operator is defined which combines the damping constants and the elements of the collision operator, when written in energy representation. The formalism is the result of an exact time integration of the Schroedinger equation. The connection with the S-Matrix formalism is discussed.

6553
THE METHODS OF SECOND QUANTIZATION AND CONFIGURATION SPACE IN THE RELATIVISTIC THEORY OF SYSTEMS OF PARTICLES. V. DERIVATION OF THE EQUATION OF BETHE AND SALPETER. Maurice Jean. Compt. rend. 233, 602-4(1951) Sept. 10. (In French)

Considerations on the second quantization transition in configuration space previously sketched (Jean, Compt. rend. 232, 1183, 1200(1951)) and used to derive two types of relativistic equations for the deuteron (Jean, ibid., 232, 2405(1951)) are extended to derive from field theory the equation of Bethe and Salpeter (Bull. Amer. Phys. Soc. 26, 22(1951)) for the stationary states of the deuteron.